POWER PLANT ENGINEERING

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The Plant of the Powers Regulator Co.

THE HEATING SYSTEM AND POWER PLANT INSTALLED IN THE HOME OF A HEAT CONTROL SPECIALIST

THE POWERS REGULATOR CO. has, after a business career of some thirty years, expanded to such an extent that a new home has become necessary. It has just moved into its recently constructed plant located in Chicago on Greenview avenue, near Diversey boulevard. This new home is a handsome brick building, with the offices in a two-story section adjacent to the shop and power plant which are in a one-story structure.

The shop roof is of the saw tooth construction with windows facing north, giving the maximum amount of light to the employes without the glare of direct sunlight.

Having specialized in automatic heat control, it will be interesting to note just how this company manages its own heating system and power plant.

HEATING SYSTEM

THE HEATING system in this plant is unique in that it is divided into three distinct sections, each of which is separately controlled by a set of thermostatic regulators.

The first section which comes into service, when the weather begins to get a little chilly, is the multiple unit fan system. There are four of these units installed, so placed, about 7 ft. from the floor, Fig. 3, that the fans maintain a circulation of air throughout the shop. This unit consists of an air passage at the intake end of which is placed a cast-iron steam radiator and at the discharge,

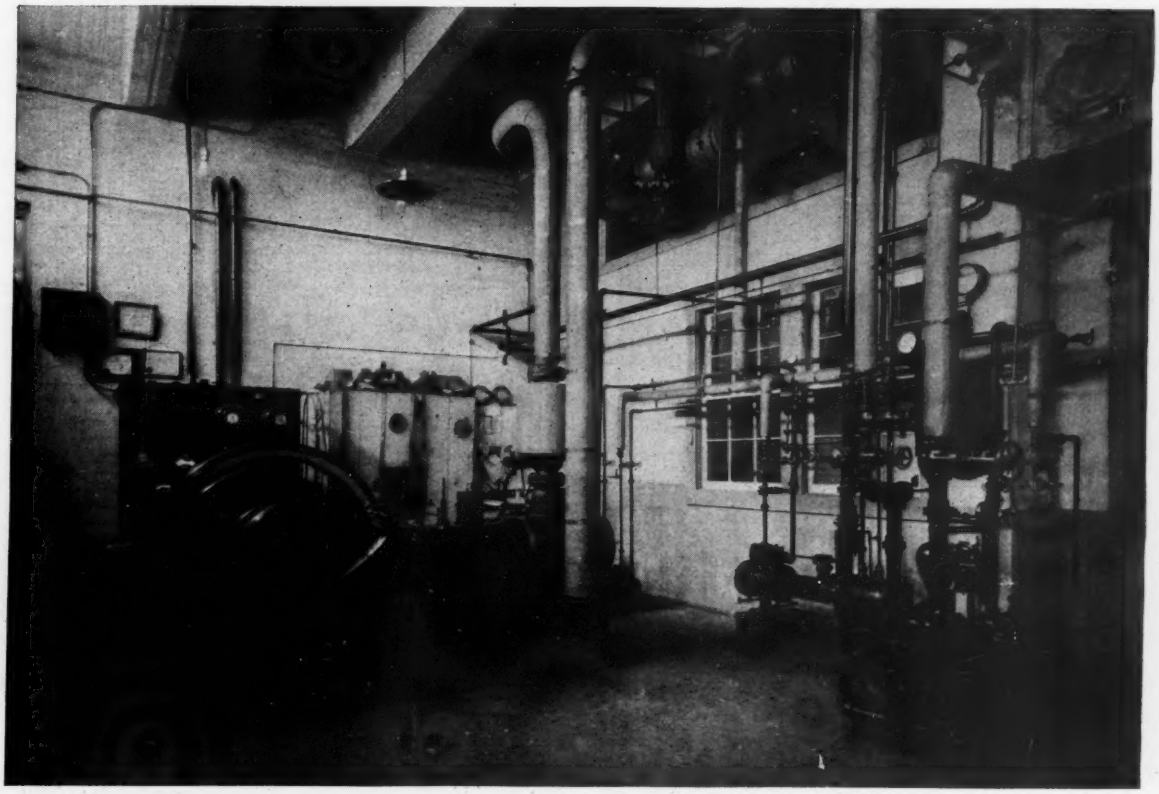


FIG. 1. ENGINE ROOM OF THE POWERS REGULATOR CO.

a fan and certain louvers that direct the flow. When circulation is necessary, that is, when the windows and skylights are closed, the fans function continuously.

DISTRIBUTION OF HEATING SURFACES

	Coil	Rad.		Coil	Rad.	Vento Equiv't.		Rad.
Basement Shipping	174	100	Shop	435	18		Office 2nd Floor	72 Wall
		100		435				18
		60		435				81
		100		435				45
		100		456				54
		100		696				54
		100			18			36
		18			18			45
	112			304				81
Office 1st Fl.				207				81
		180 Wall		248				27
		65 = 3-Col.38°				194 = 776		18
		65 " "				194 = 776		18
		90 " "				96 = 384		96
		54 Wall				96 = 384		72
		54 "						72
		100 = 3-Col.38°			18			
		72 " " 45°						

There is a thermostat placed directly in front of the radiator that actuates a regulator on the steam line leading to the heating coils. When the temperature in the shop falls below a predetermined point, say 68 deg. for a shop of this kind, the regulator valve opens and admits steam to the coils. Two of these units have a heating surface of 96 sq. ft. each and two have 194 sq. ft. each.

When the wall coils come into action. These coils, about ten 1¼-in. pipes high are run along the outer exposed wall behind and below the work benches. They are divided into a number of sections as indicated in the plan of the shop, Fig. 2. The air flows over these surfaces, up along the wall, over and down into the middle of the room. These sections of coil are controlled by thermostats placed about the interior of the shop. These thermostats are set for a slightly lower temperature than those used in the control of the fan units, and when the weather becomes so cold that the fan units will no longer maintain the desired temperature, these thermostats open their controlling valves and allow steam to pass into the wall coils.

Directly below each row of skylights is a horizontal bank of heating coils which intercept the cold down drafts from the windows. Thermostats set at 64 deg. are placed directly below these coils and operate to bring them into service when these down drafts occur.

The combined heating surface of the fan units is 580 sq. ft., actual, which is equivalent to 2320 sq. ft. of direct radiating surface. The wall radiation consists of 2197 sq. ft. of wall coils and 2299 sq. ft. of radiators; the roof coils present a surface of 1740 sq. ft., making a total of 8556 sq. ft., as shown in the table.

The radiator and coil supply pipes and the supply and return mains are proportioned with regard to the

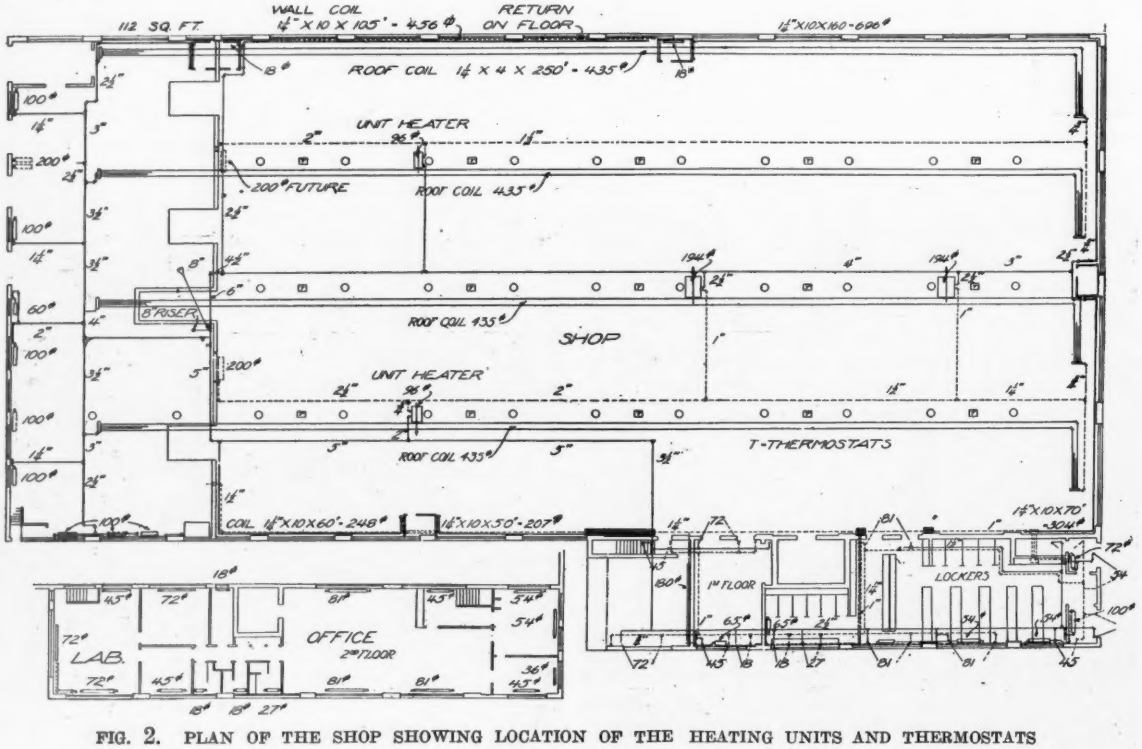


FIG. 2. PLAN OF THE SHOP SHOWING LOCATION OF THE HEATING UNITS AND THERMOSTATS

square feet of heating surface served according to the following schedule:

Coil Supply		Supply Mains		Return Mains	
in.	sq. ft.	in.	sq. ft.	in.	sq. ft.
¾	80	1	70	½	130
1	81-125	1½	210	¾	460
1¼	126-175	2	460	1	870
1½	176-300	3	1430	1¼	2190
2	301-600	4	3120	1½	4260
		5	5680	2	5680
		6	9390	2½	9390

The heating system is supplied with exhaust steam from the generator engine and auxiliaries at 1 to 3 lb. pressure, and a vacuum of 8 to 10 in. is maintained. This pressure may be increased if occasion demands, and

any further increase in heat requirements will be supplied by live steam through a reducing valve.

Power Transmission

The power distribution presents an interesting feature of this plant. The entire absence of all overhead line shafting and counter shafts with the accompanying

FIG. 3. HEATER AND FAN UNIT

multiplicity of belts and pulleys is conspicuous. All transmission is done electrically on the three-wire system. Each machine, lathe, punch, drill-press, milling machine, has its own individual motor mounted, in some cases on a frame integral with the frame of the machine, as in Figs. 4 and 5, in some cases on a platform built on one of the roof columns, Fig. 6. In no case is the distance between the motor shaft and the pulley on the

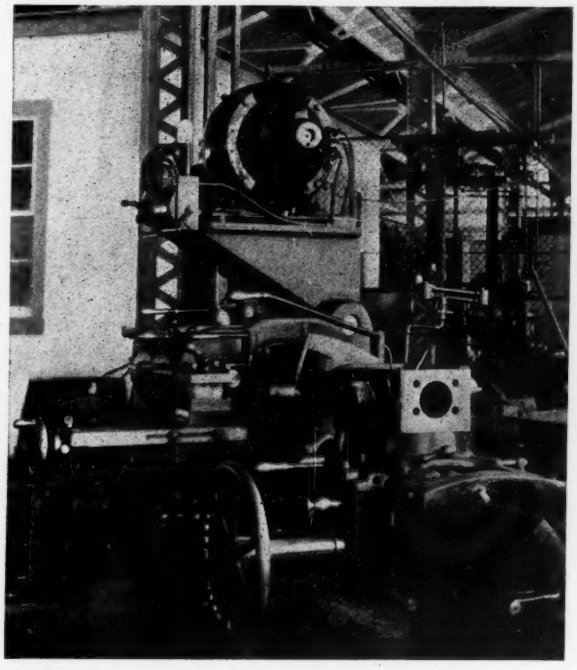


FIG. 4. INDIVIDUAL MOTOR MOUNTING

machine more than 3 or 4 ft. and the drive in all cases is by means of short belts which are preferable to gears. With this equipment power is used only when the machine is in operation and the great waste ordinarily involved in the continuous operation of overhead shafting is avoided. An estimated power saving of fifty per cent results from the use of this individual motor drive system. Individual motor drive also permits of setting machines at an angle with the building, which results in an economy of floor space with light from exactly the desired quarter.

Figure 7 is a view of a fuse box showing the bus bars and distributing leads with the necessary fuses. Lighting fuses are also placed in this box. There are several of these control centers located at various points throughout the plant, one for each section of the shop.

Power Plant

The power plant, Fig. 10, which supplies this shop, is particularly complete. It contains all the elements of a modern station with a present output of about 50 kw. It is located in the basement under one corner of the shop.

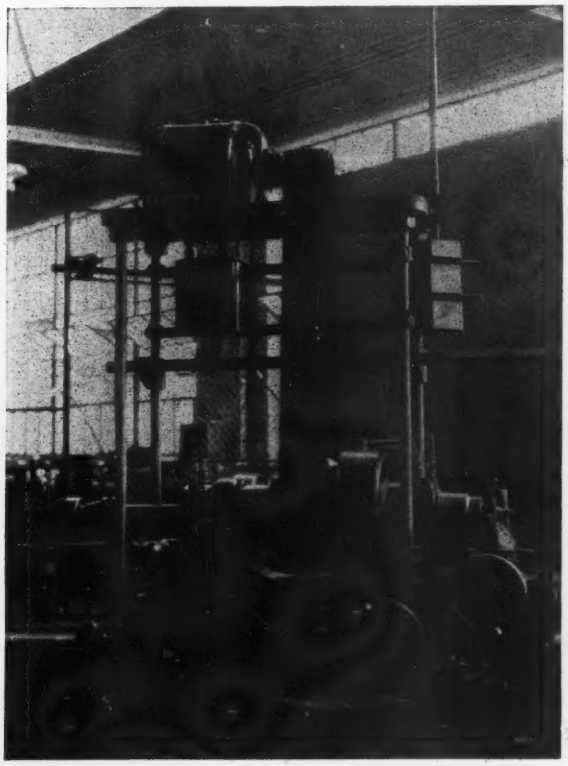


FIG. 5. MOTOR MOUNTED ON FRAMEWORK ABOVE A LATHE

The boiler is of the return tubular type rated at 100 hp. 66 in. by 18 ft., having fifty-four 4-in. tubes, Fig. 8. It is interesting to note that, contrary to usual practice, the blowoff tank is placed some distance above the top of the boiler. This design is to provide gravity drainage of this tank to the sewer.

A soot blower which is designed to dust all tubes at one operation by opening one live steam valve and then turning a handle on a radial pipe equipped with steam nozzles is installed to insure clean fire tubes.

A vertical, centrifugal, motor-driven sump pump is provided to discharge any waste water that necessarily collects below the sewer level.

The brick setting is designed for alternate hand firing; a shaking grate is provided, having an area of 30 sq. ft. The arch is of the City of Chicago No. 6 type. At present, No. 4 Illinois wash nut coal is being used

with satisfactory results. Little or no smoke results from its combustion. During the summer months, about

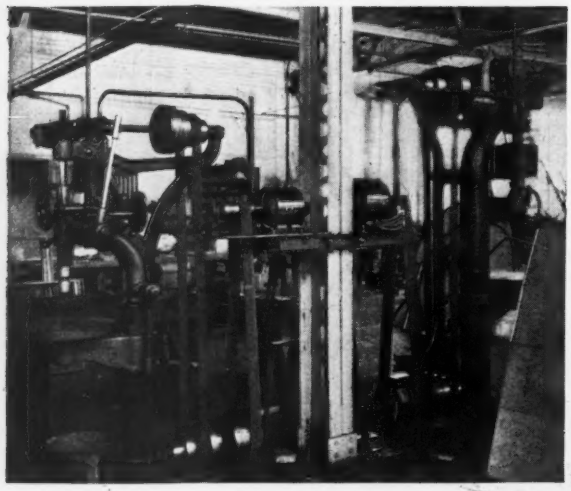


FIG. 6. INDIVIDUAL MOTORS MOUNTED ON ROOF COLUMN

one and one-half tons of coal are consumed per day of 24 hr. Steam is supplied at 80 lb. pressure for 9 hr. of the day and during the night the fires are banked. An average actual evaporation of 6½ lb. of water per

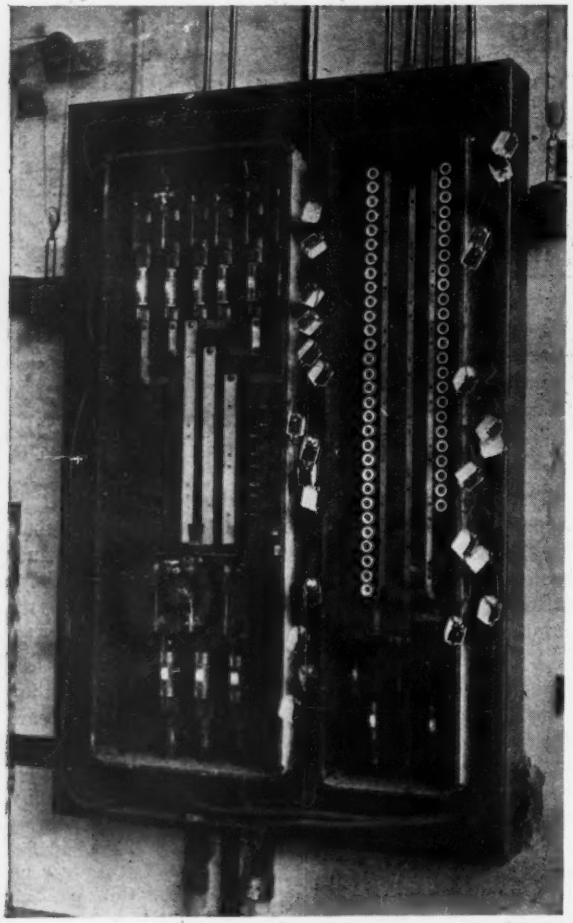


FIG. 7. FUSE BOX SHOWING DISTRIBUTING BUSSES

pound of coal is claimed for this installation. During the heating season, the exhaust steam is all utilized, first by weighting the back pressure valve and then further requirements are met by live steam which is admitted into the heating system through a pressure reduction valve. A very considerable amount of high pressure steam is required in some of the factory processes.

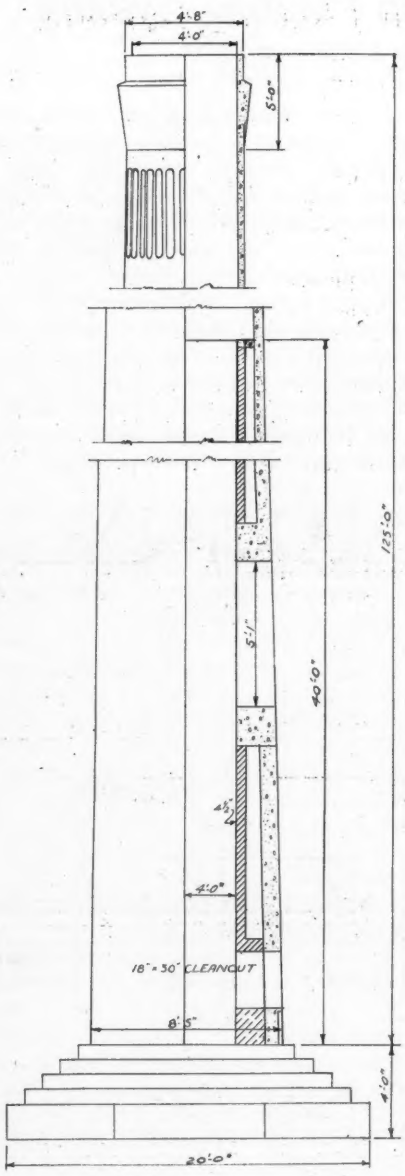
Directly off the boiler room and beneath a driveway is a storage bin of about 150 t. capacity. The plant is not conveniently located to receive coal direct from a railroad siding, so that the fuel as well as the ash must be handled by truck. For this reason it is economical to purchase a good grade of coal with a low ash content. The coal is dumped from the trucks through manholes directly into the bins necessitating no re-handling. The ash is shoveled into cans and lifted on a freight elevator to the street level where it is carried away by trucks.

A superabundance of draft is supplied by a stack

FIG. 8. BOILER SETTING

125 ft. high and 4 ft. in diameter which has been erected to take care of two boilers, Fig. 9. At present there is but one boiler installed and use is made of the surplus to ventilate the boiler and engine room by opening the breeching cleanout door at the ceiling. There is a light placed on one side of the breeching opposite the ventilating door by means of which the fireman is able to see the amount of smoke being formed and regulate his fires accordingly. This stack is of re-inforced concrete construction with an innerliner of fire brick reaching up to a height of 40 ft. The liner consists of one course of brick and is built with an annular space 6 in. wide between it and the concrete casing.

There are two cylindrical tanks, 4 by 12 ft., one for cold and the other for hot water, located beside the boiler, that are used for testing various apparatus manufactured. Each of them is provided with a duplex 10 by 6 by 12-in. pump which by a special controlling



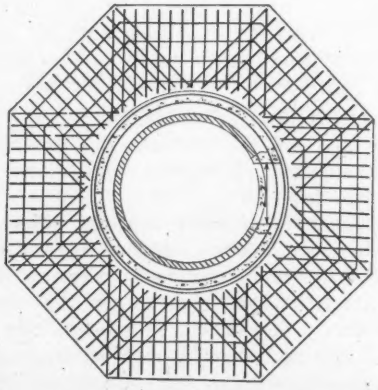


FIG. 9. DETAILS OF THE CHIMNEY

apparatus will afford any desired pressures up to one hundred pounds.

The engine room is directly adjacent to the boiler room, Fig. 1. It is designed to accommodate two engine units but at present there is only one installed. This consists of an automatic high speed slide valve engine 11 by 12 in. running at 290 r.p.m. noncondensing, direct connected to a three-wire 125-250-v. 200-amp. direct-current generator. There are two panels on the switchboard which contains two ammeters, one d. c. voltmeter, a watthour meter, service switches and circuit breakers.

Back of the engine is located a 5 by 7 by 10-in. simplex vacuum pump that serves the heating system; a 7 by 6½ by 10-in. air compressor that supplies the factory with compressed air for burners, pneumatic tools,

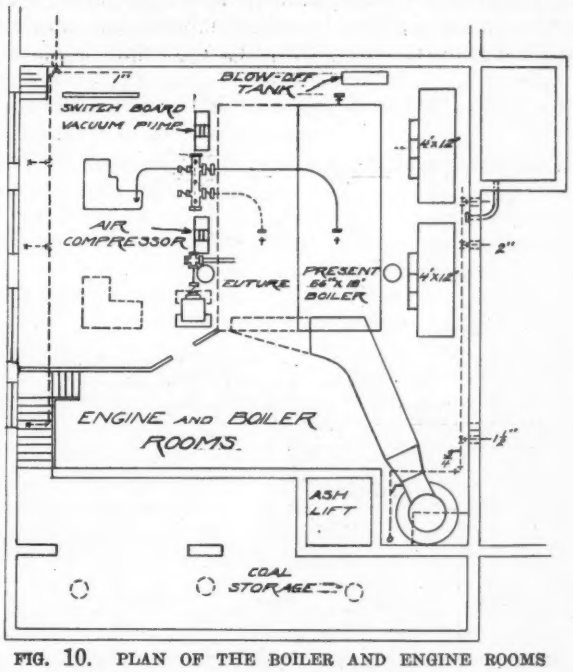


FIG. 10. PLAN OF THE BOILER AND ENGINE ROOMS

etc., and a 6 by 4 by 6-in. boiler feed pump. Above this latter is a 500-hp. open feed water heater which takes city water at an average of 60 deg. and delivers it to the boiler feed pump suction at 210 deg. This heater is of sufficient capacity to take care of the present and future installations; it is fed with steam by induction and is equipped with an oil separator and drip. This heater is fitted with two float controlled inlet valves, one for cold make-up water from city and the other water from the receiving tank which collects all pure hot water from the heating system. This tank is on the floor above so that it drains to the heater and is fed by the condensed steam returned from the vacuum pump.

The whole plant has been carefully and conveniently laid out, and always with an eye to the future. Space is left for the duplication of boiler, generator unit and accessories. In making additions to the shop equipment all that is necessary is to set up the machine with its motor attached in the space designed for it and make the necessary electrical connections; machine locations may be changed with similar ease, the entire proposition possessing an elasticity that is most desirable.

Eliminating Water Hammer in Heating Systems

Various Causes of Water Hammer and Systems of Piping Which Have Proved Successful. By Charles L. Hubbard

THE operating engineer of any large building, whether it be a factory, office building, or public institution, has probably experienced more or less difficulty at times in obtaining a satisfactory circulation of steam through his heating system, especially when first warming up the building in the morning. Imperfect circulation may manifest itself by surging and snapping in the pipes or radiators, commonly known as "water hammer," or by certain sections of the radiation remaining cold or at a temperature much below that of the steam in the system. In certain cases, conditions will gradually improve until in the course of an hour or two circulation will be well established and continue so throughout the remainder of the day; while in others, the action is reversed, and water hammer may not develop until after the system has been in operation for some considerable length of time.

Assuming the piping to be of ample size, practically all of the difficulties enumerated may be traced to three causes, as follows: Low points in the piping where condensation may collect; piping arrangements which allow "short-circuiting" of pressure, thus holding back the condensation from more distant points; and imperfect air venting.

The first two conditions usually produce water hammer and the last poor circulation and cold radiators.

Water Hammer

This may consist of a gentle surging or "boiling" in the pipes, and snapping which may vary from a noise scarcely audible up to a heavy blow sufficient to fracture a heavy fitting. Water hammer can take place only when both steam and water are present and when there exists a difference in temperature between the two sufficient to cause a rapid condensation of the steam.

There is a condition also called water hammer which occurs in cold-water pipes where no steam is present, this being due to the momentum of the water in a pipe set in motion by the opening of a faucet. If the faucet is closed too suddenly and there is no air cushion at the end of the pipe line, a heavy blow will be struck when the water is brought suddenly to rest. Conditions of this kind may be overcome by providing air chambers at the ends of all branches which have faucets connecting with them.

The action of water hammer in steam pipes may be briefly described as follows: Suppose there is a slight sag in a pipe so that water stands for a certain distance along the bottom. When steam enters the pipe at a fairly high velocity, it ruffles the surface of the water, causing it to catch and envelop bubbles of steam which are instantly condensed by contact with the cooler water. This action leaves a vacant space or vacuum where the

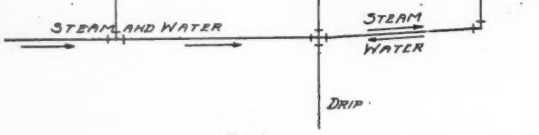


FIG. 1

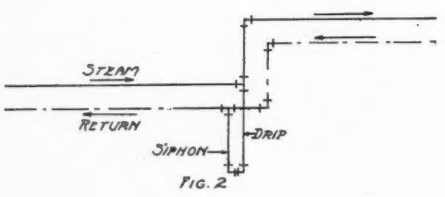


FIG. 2

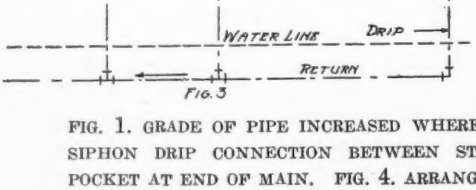


FIG. 3

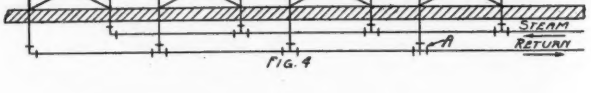


FIG. 4

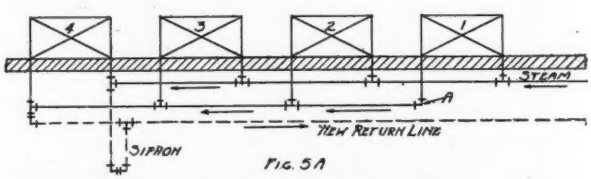


FIG. 5A

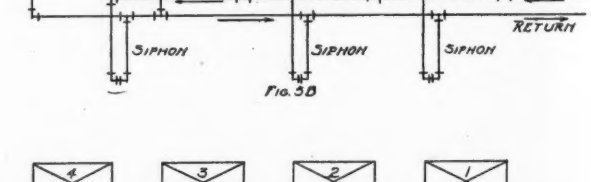


FIG. 5B

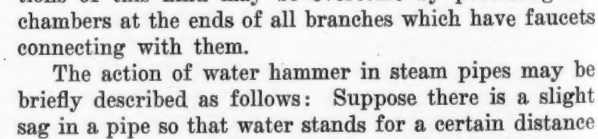


FIG. 5C

FIG. 1. GRADE OF PIPE INCREASED WHERE STEAM AND WATER FLOW IN OPPOSITE DIRECTIONS. FIG. 2. SIPHON DRIP CONNECTION BETWEEN STEAM MAIN AND CONDENSATE RETURN MAIN. FIG. 3. DRIP POCKET AT END OF MAIN. FIG. 4. ARRANGEMENT OF PIPING WHICH CAUSES SHORT CIRCUITING. FIG. 5. THREE ARRANGEMENTS OF PIPING WHICH PREVENT SHORT CIRCUITING AND RESULTANT WATER HAMMER

steam bubble previously existed, causing the water to close in suddenly to fill the vacancy. This produces the snappy sound with which every engineer is familiar, the severity depending principally upon the size of the bubble and its depth below the surface of the water. Each time this action takes place it produces more agitation of the water, which in time tends to increase the size of the steam bubbles enveloped, until finally the movement of the water in filling these vacant places becomes so great as to start leaks in the pipe joints or even fracture fittings, to say nothing of the annoyance produced by the noise when the action is not sufficiently severe to damage the piping.

At this point, it may be well to mention water hammer in boilers and the great damage which may be associated with it under certain conditions. This commonly occurs when a boiler which has been idle is being cut into a steam main under pressure. If the pressure in the "closed-in" boiler is raised to a point above that in the main, before the stop valve in the connection is opened, there will be a tendency to "lift" the water in considerable quantities, which may be thrown against the shell with sufficient force to cause rupture if the valve is opened too quickly or the pressure difference is too great. On the other hand, if the valve is opened before the pressure in the boiler has reached that in the main, steam will rush in and force comparatively large bubbles well below the surface of the water in the boiler, thus producing heavy shocks when they condense. It can be shown by computation that when steam at 100 lb. pressure is admitted to a boiler having a pressure 7 lb. less, a steam bubble, 6 in. in thickness formed 3 in. below the surface of the water, will produce, upon condensation, a pressure due to water hammer of over 2000 lb. per sq. in., in addition to the steam pressure already existing in the boiler. This shows the great danger of the more or less common practice of cutting in a boiler as soon as its pressure reaches a point within 10 or 15 lb. of that existing in the main with which it is to be connected.

In all cases of this kind, the pressure in the boiler to be cut in should be brought as nearly as possible to that existing in the main, after which the valve should be opened very slowly until the pressures become fully equalized.

Going back to the matter of water hammer in steam pipes, the first step in the way of elimination is to do away with all low points for the accumulation of condensation, either by regrading or by dripping. In general, the piping should be so arranged that the flow of water toward the point of drainage will be with the steam rather than against it. If, however, a line of piping extends but a short distance beyond a drip connection and it is not convenient to drip again at the end of the line, the pipe extension should be of ample size and be given a good pitch downward toward the point of drainage as shown in Fig. 1.

Whenever there is a rise in a heating main the bottom of the vertical pipe should always be dripped into the return, which may be done through a siphon loop if the two pipes are under approximately the same pressure, that is, when there is no reducing valve between the steam and return lines, see Fig. 2. In general, there will be but little trouble from water hammer due to pockets in modern plants, as the matter of drainage is pretty well understood by the well-informed steamfitter; however, it is always well to look for this cause when running down trouble of this kind.

As there is an excess of condensation when steam is first turned into a system of cold piping it is well to provide a receiving pocket on the ends of large and important mains, as shown in Fig. 3, to prevent flooding.

One of the most frequent causes of water hammer, and also one of the most difficult to locate in many cases, is short-circuiting. This condition is most likely to occur in systems having long runs of horizontal piping where the pressure tends to fall somewhat at the more remote portions, due to frictional resistance in the piping. Great care must be taken in cases of this kind not to drip near-by radiation directly into returns coming from a distance, as the higher pressure admitted by these connections will tend to hold back condensation coming from points beyond. Figure 4 illustrates this condition and shows how the return from certain radiators may cut off that from others beyond, while remedies for this are given in Figs. 5A, B and C.

The arrangement in Fig. 4 is more or less common in one form or another and the principle involved is responsible for much of the trouble experienced from water hammer in low-pressure heating systems having a gravity return. In this case, a supply branch is run out to care for several radiators and an overhead or "dry" return brought back as shown. It is evident that the pressure will drop slightly between radiators No. 1 and No. 4, owing to the greater distance from the steam main; hence, the return from radiator No. 1 admits a pressure into the return main slightly greater than exists in No. 2, and appreciably greater than in No. 4, thus producing a condition which tends to hold back condensate from the end of the line and cause singing and snapping in the return at the point A. In Fig. 5A this is overcome by adding another line of pipe as shown dotted, and disconnecting and plugging the old line at A. With the new arrangement the extreme end of the return line starts with the drip from radiator No. 1, where it receives the highest pressure, the next lowest at No. 2, and so on, thus reversing the conditions existing in Fig. 4, so that any variation in pressure in the return line tends to force the condensation toward the boiler or receiving tank instead of retarding it. The end of the supply pipe is dripped into the return through a siphon loop of sufficient length to balance by the water seal any difference in pressure which may exist between the supply and return at this point. This arrangement is somewhat more expensive to install, owing to the extra line of pipe, but the more satisfactory operation is well worth the extra cost in many cases.

In Fig. 5B, a single return line is used, but the first radiators are drained through siphon loops which seal the returns and prevent steam from entering and holding back the water from the end of the line. Pressure for forcing the water toward the boiler is admitted through the drip connections from radiators Nos. 3 and 4.

The plan shown in Fig. 5C is simple and may often be employed when the distance B from the return line to the radiators is from 18 to 24 in. The end of the

supply pipe in this case is dripped directly into the return line in order to balance the pressure at this point and cause the condensation from the more distant radiators to flow toward the receiving tank. Any tendency of backing into radiators Nos. 3 and 4 is prevented by inserting check valves in the returns as shown in the cut. The extra force required to raise the checks against the slightly higher pressure in the return being furnished in this case by a short column of water above the checks which does not interfere in any way with the drainage of the radiators, provided the height B is sufficient to prevent its reaching to the radiator.

Another case which frequently gives trouble, and is often overlooked, is where the run-out to a single-pipe radiator pitches slightly in the wrong direction, as shown in exaggerated form in Fig. 6. When the distance from A to B is comparatively short, it is customary to drain the condensation back into the steam main, taking drips from the latter at a sufficient number of points to keep it clear. A slight pitch in the wrong direction, even though there is ample space at A for the steam and water to pass, will frequently cause a sufficient quantity of the latter to collect to produce snapping and water hammer in the manner previously described. This action, in turn, accelerates condensation

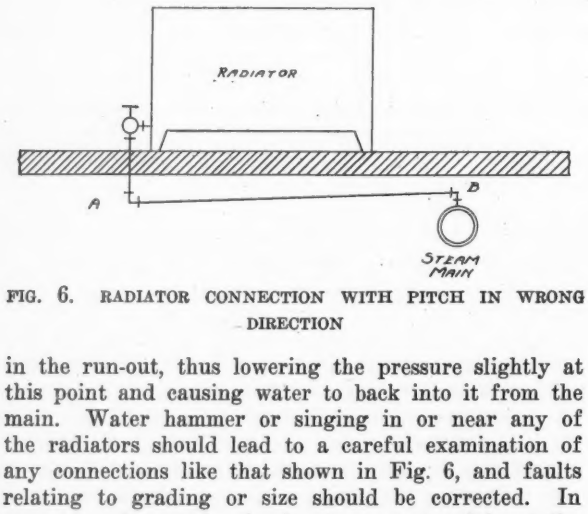


FIG. 6. RADIATOR CONNECTION WITH PITCH IN WRONG DIRECTION

in the run-out, thus lowering the pressure slightly at this point and causing water to back into it from the main. Water hammer or singing in or near any of the radiators should lead to a careful examination of any connections like that shown in Fig. 6, and faults relating to grading or size should be corrected. In some cases it may be simpler to connect a drip at the point A leading to a sealed return, than to attempt the changes noted above.

Another case which sometimes gives trouble is where a large building or group of buildings is heated with live steam under low pressure and the condensation returned directly to the boilers by gravity. Where there are long horizontal mains and branches operating in this manner, any slight change in boiler pressure will tend to destroy the balance between different parts of the system and thus start a singing which soon results in severe water hammer. As it is practically impossible to carry a perfectly uniform pressure on a heating boiler at all times, it is usually necessary in case of this kind to raise the steam pressure to 10 or 15 lb. and reduce it on the heating system to 2 or 3 lb. as may be required. With this arrangement, fluctuations in boiler pressure are not communicated to the heating system, which remains uniform at all times. Under these conditions, it will be necessary to use a return trap or small electric pump for returning the condensate to the boilers against the higher pressure. In some cases it is better to carry a somewhat higher boiler pressure and employ a direct-acting steam pump for this purpose.

In general, sealed returns should always be employed, especially for the mains. The various drips may often be brought together overhead in groups of two to four, when more convenient, following out the principle illustrated in Fig. 5A, to avoid short-circuiting, and connecting the branch pipes thus formed with the main sealed return.

When a return-line vacuum system is employed it does away with all difficulties when properly installed, and this is sometimes the simplest solution of a noisy system and is easily attached to any two-pipe arrangement having a gravity return to the receiving tank. When trouble from sluggish circulation and water hammer occurs only for a time in the morning when steam is first turned into the system, it is often sufficient to apply a suction to the main return for a short time until the pipes and radiators are free from air and excess condensate. This may be done either by means of a pump or ejector connected into a bypass near the receiving tank.

Power

By J. M. James

WHAT daily turns the commerce wheels,
And ends the tasks, that labor feels,
Awakens life, and stills the hour?
That mighty monarch, Power!

What grips the minerals from the earth
And molds them into peerless worth,
Builds the hut, and skyward tower?
That might of muscle, Power!

What tills the land of golden grain,
To fill the maws of a vast domain,
Makes greed of monarchs cringe and cower?
That rock of right, Power!

What loads our ships for lands apart
And guides them to a waiting mart,
Makes might of men a birthright dower?
That tireless force, Power!

What welds the sinews of lands oppressed,
Makes King and peasant doubly blest,
Crushes greed that would devour?
That earth born source, Power!

Who gives to man this forge of force
To conquer seas, and tempest's course,
To delve beneath the seas and land,
To speak with man on foreign strand?

'Tis He Who lights the stars above
And fills our hearts with wondrous love,
Molds mountain, sea, and nature's bower,
To whom all must answer, Power!

Stocks and Production of Bituminous Coal

COAL IN HANDS OF CONSUMERS MARCH 1 AND JUNE 1, 1920; WEEKLY REPORT ON PRODUCTION OF COAL. PREPARED BY F. G. TRYON FOR THE U. S. GEOLOGICAL SURVEY IN CO-OPERATION WITH THE U. S. BITUMINOUS COAL COMMISSION AND THE COUNCIL OF NATIONAL DEFENSE

COMMERCIAL stocks of bituminous coal in the United States on June 1, 1920, are estimated at 20,000,000 net tons. This was considerably less than the stocks carried on Oct. 1 of the years 1916 and 1917, and was very much less than the stocks accumulated at the close of 1918. In the three months from March 1 to June 1, 1920, stocks decreased 4,000,000 tons, or 17 per cent.

These figures are estimates which attempt to account for coal in the hands of railroads, industrial consumers, public utilities, and retail dealers. They do not include coal in the cellars of domestic consumers, coal in stock for steamship fuel, or coal in transit. The stocks on the lake docks are not included, because they are properly to be regarded as coal in transit and because naturally they vary greatly from winter to summer.

TABLE I. SUPPLY OF SOFT COAL IN HANDS OF VARIOUS CLASSES OF CONSUMERS

(In net tons)

Destination	New York	Philadelphia	Baltimore	Hampton Roads	Charleston	Total dumped
Aug.29-Sept.4						
Coastwise to New England	106,000	16,000	48,000	139,000	-------	309,000
Exports	-------	117,000	58,000	281,000	13,000	469,000
Bunker	109,000	12,000	8,000	60,000	3,000	192,000
Inside capes	-------	36,000	31,000	6,000	-------	75,000
Other tonnage	184,000	-------	-------	3,000	2,000	189,000
Total	399,000	183,000	145,000	489,000	18,000	1,234,000
Sept.5-12						
Coastwise to New England	111,000	14,000	38,000	98,000	-------	261,000
Exports	-------	81,000	112,000	237,000	9,000	439,000
Bunker	126,000	13,000	12,000	54,000	2,000	207,000
Inside Capes	--------	48,000	28,000	5,000	1,000	82,000
Other tonnage	188,000	4,000	------	11,000	------	203,000
Total	425,000	160,000	190,000	405,000	12,000	1,192,000

As reported to the Geological Survey by the Tidewater Coal Statistical Bureau.

Information available concerning stocks of coal in the past is summarized in the following table:

TOTAL COMMERCIAL STOCKS OF BITUMINOUS COAL IN THE UNITED STATES OCT. 1, 1916, TO JUNE 1, 1920

	(Net tons)
Oct. 1, 1916	27,000,000
Oct. 1, 1917	28,100,000
July 15, 1918	39,700,000
Oct. 1, 1918	59,000,000
Day of the armistice	63,000,000
Jan. 1, 1919	57,900,000
April 1, 1919	40,400,000
March 1, 1920	*24,000,000
June 1, 1920	*20,000,000

*Subject to revision.

The record of stocks does not extend back far enough into the past to make it possible to state just what constitutes normal on June 1. The fact that stocks on that date were less than a third of the war-time maximum does not prove that they are dangerously low, because the reserve built up during the war was admittedly very large. Furthermore, the reserve needed on June 1 is not as great as that required on the approach of winter. It is clear, however, that seven or eight million tons must be put in storage between June 1 and Oct. 1, in order to bring stocks up to the standard of 1916 and 1917. Yet in neither 1916 or 1917 were the stocks adequate. The stocks in 1916 were not sufficient to prevent increases of price ranging from 100 to 200 per cent in the winter of 1916-17. The stocks in 1917 were not sufficient to prevent physical suffering and widespread closing down of plants in the severe winter of 1917-18.

The reserve on March 1, 1920, shown in Table I, was sufficient for 2 weeks, 4 days, and that on June 1 for 2 weeks and 1 day. Not only was the average for all consumers low, but, as the table shows, the stocks of each of the seven great groups of consumers were lower than on any of the seven preceding dates for which

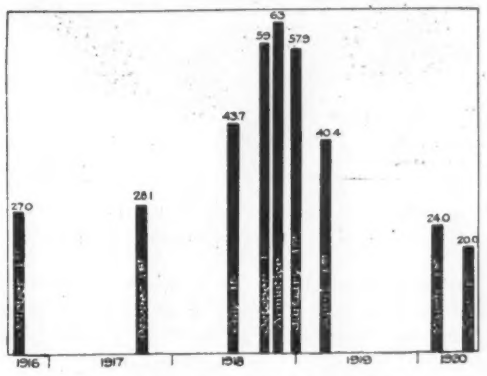


FIG. 1. TOTAL COMMERCIAL STOCKS OF BITUMINOUS COAL OCT. 1, 1916, TO JUNE 1, 1920. FIGURES REPRESENT MILLIONS OF TONS

records are available. Like all averages, these figures may be misleading. Some localities are better off than others. Individual plants will have much more than the average, and many plants may have virtually no stock when the average shows an adequate supply.

Stocks of railroad fuel were far below those held by the railroads at any time during the last 4 yr., the period over which records extend. The decrease was most marked in the eastern district, particularly New England. Depleted stocks of railroad fuel are significant because they indicate that the roads may have to confiscate coal or assign cars freely, measures which necessarily interfere with regular deliveries to other consumers.

Incomplete figures indicate that stocks at by-product plants averaged 15 days' supply on March 1. During the switchmen's strike the stocks of by-product coal decreased sharply in New England, New Jersey, and the six states north of the Ohio and west of Pennsylvania dependent on shipments from the Appalachian region. The average stock on June 1 was exceptionally low—eight days' supply.

Stocks at steel plants, estimated from incomplete data, averaged 9 days' supply on March 1, but little more than the stock in January, 1918. Steel plants were able to increase their stocks slightly during the switchmen's strike and had on June 1 an average of about 11 days' supply.

Stocks of coal at electric-utility plants averaged 3 weeks' supply on March 1. This was 58 per cent less than on April 1, 1919, 11 mo. before. Individual plants held stocks much below the average. Like the steel plants, electric utilities were able to increase their average holdings slightly from March 1 to June 1.

Gas coal was in particularly short supply during the switchmen's strike, and the average stocks at coal-gas plants decreased from 31 days' supply on March 1 to 22 days' supply on June 1. These stocks were only

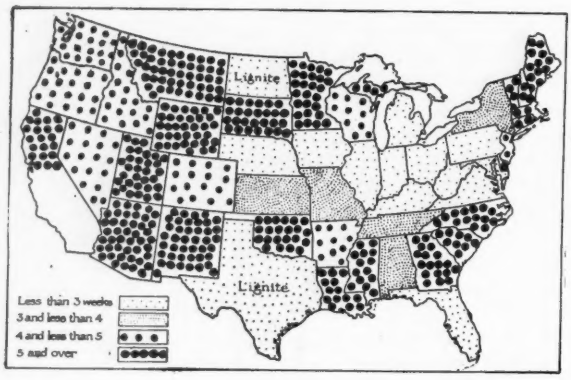


FIG. 2. STOCKS IN INDUSTRIAL PLANTS OTHER THAN STEEL AND BY-PRODUCT MARCH 1, 1920

about a third or fourth of the war-time maximum, and the decrease was very uneven. Plants in the Northwest and Northeast were on the whole in a less favorable position than plants in the West and South.

Retail stocks of bituminous coal averaged one week, six days' supply on March 1, less than half the supply on April 1, 1919, 11 mo. before. From March 1 to June 1, stocks increased in the South and Southwest, but de-

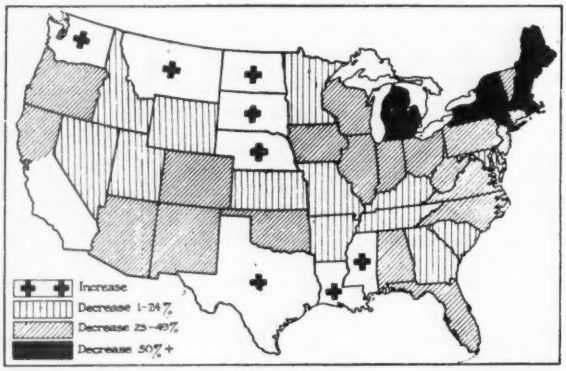


FIG. 3. HOW STOCKS ON MARCH 1, 1920, COMPARE WITH THOSE OF APRIL 1, 1919

creased in the North. The far West and Southeast were in relatively favorable position. In the Northeast and territory served by the lake docks, the situation was relatively unfavorable.

Retailers' stocks of anthracite on June 1, 1920, were in better condition than their reserves of bituminous coal. Pennsylvania anthracite averaged 14 days' supply, as against 10 days' supply of soft coal.

Industrial plants other than steel and by-product plants dropped from an average of 27 days' supply on March 1 to 24 days' supply on June 1. In comparison with those shown by past records, these stocks were low. Quite as significant as the general average of stocks was the distribution of stocks from state to state, which had been profoundly affected by two disturbing factors—the bituminous coal strike of November-December, 1919, and the railroad switchmen's strike beginning April 1, 1920. The distribution of industrial stocks is the best index to the abnormal features brought about by these causes.

On March 1, 2½ mo. of large production had not entirely overcome the effects of the coal miners' strike. West of the Mississippi and south of the Ohio and Potomac, stocks compared not unfavorably with those of the preceding year; in eight states they had increased and in only 11 states had they decreased more than 25 per cent. North of the Ohio and Potomac, in the great industrial section of the country, stocks had been greatly depleted and in general ranged from 33 to 68 per cent lower than the year before.

From March 1 to June 1, stocks increased in states not dependent on fields that were affected by the switch-

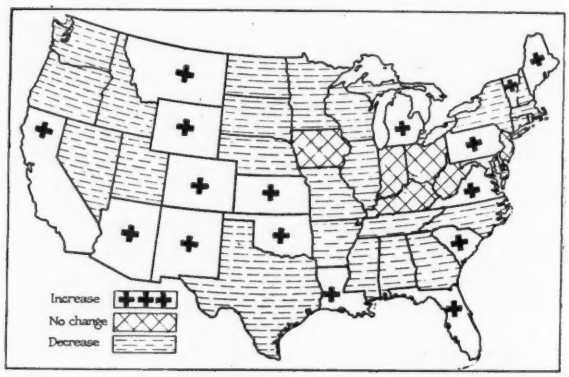


FIG. 4. CHANGES IN INDUSTRIAL STOCKS FROM MARCH 1 TO JUNE 1, 1920

men's strike. In the far West, stocks increased, except in Washington and in states dependent on Utah, which had felt the strike. In the South, stocks generally decreased. In the industrial Northeast, consumers at short-haul destinations received a larger proportion of the total output than usual and either maintained or increased their stocks. At the long-haul destinations—New England, New York, and territory served by the lake docks—stocks generally decreased.

The switchmen's strike emphasized the inequalities in distribution which had been created by the coal miners' strike. On June 1 stocks in the Great Plains, Rocky Mountain, and Pacific Coast states compared not unfavorably with those of midsummer of even the war year, 1918. In the Southeast stocks showed a consistent decrease as compared with the war year, but in only one state did the decrease amount to 50 per cent. In the region north of the Ohio and Potomac, from Illinois to New England, the decrease exceeded 50 per cent in every state except Delaware. In parts of New England and the southern peninsula of Michigan, the decrease amounted to 65 per cent.

These facts show clearly that although the stocks at some places in the West and South were low, the territory of depleted reserves is the industrial section north of the Ohio and Potomac and east of the Mississippi, together with Missouri and Iowa and that part of the Northwest which is supplied from the lake docks.

Weekly Report of Coal Production

The week of Labor Day—Sept. 6-11—was no exception to the rule that a holiday week in time of car shortage shows a decrease in total production but an increase in the rate per working day. The total output of soft coal, including lignite and coal coked, is estimated at 10,566,000 net tons, a decrease compared with the preceding six-day week, of 605,000 tons. Loadings on Labor Day itself were 7802 cars, as against a daily average for the week before of 34,000 cars.

The observance of the holiday acted to improve the car supply on the remaining working days of the week, and largely as a result of this, the rate per day worked rose to 1,994,000 tons, the highest attained in any week since last January.

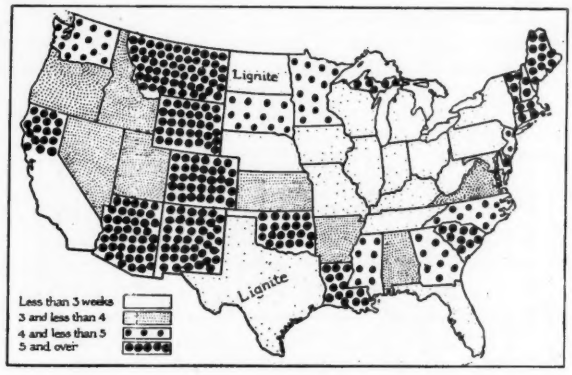


FIG. 5. STOCKS AT INDUSTRIAL PLANTS, JUNE 1, 1920

Telegraphic reports from the principal carriers indicate that loadings continued heavy on Monday and Tuesday of the present week (Sept. 13 and 14).

Production during the first 217 working days of the last 4 yr. has been as follows (in net tons):

1917	384,069,000	1919	318,410,000
1918	411,523,000	1920	369,143,000

The year 1920 is thus fifteen million tons behind 1917, and forty-two and a third million tons behind 1918, but is fifty and three-quarter million tons ahead of 1919. In this connection, it should be remembered that production during 1918 exceeded consumption and provided for a net addition to consumers' stocks by the end of the year of approximately 30,000,000 tons. In 1919, the condition was reversed; consumption exceeded production and there was a net draft on stocks of perhaps 40,000,000 tons for the year.

Judging by the test of production, the anthracite strike closed down about 70 per cent of the capacity of the anthracite region of Pennsylvania during the week ended Sept. 11. This was the first full week since the walkout began. Cars of hard coal loaded at the mines for shipment during the week ending Sept. 11, numbered 10,640, as compared with 35,388 during the week of Aug. 28. Expressed in net tons, the total quantity shipped, used for mine fuel, and sold locally, was probably about 546,000. These figures are, if anything, somewhat above the colliery production because of the possibility of drawing on accumulations of coal at the mine for shipment.

Up to Wednesday of the present week (Sept. 15) men had not returned to work in significant numbers, so far at least as records of shipments indicate. On that day reports from eight carriers loading 94 per cent of

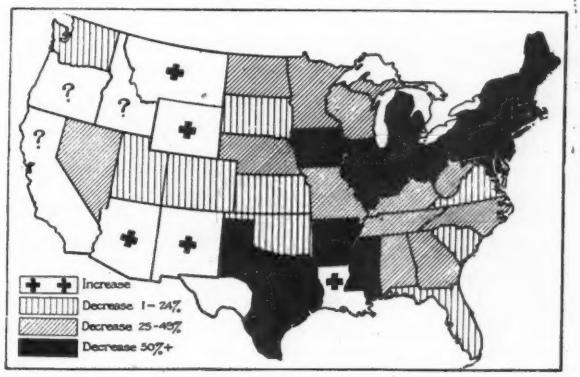


FIG. 6. HOW STOCKS ON JUNE 1, 1920, COMPARE WITH THOSE ON JULY 15, 1918

the total tonnage in the anthracite region, showed only 35 per cent of the pre-strike average.

Total Production of Coal

The necessity of partially replacing anthracite with bituminous coal in the event of a protracted strike, makes it pertinent to consider the two kinds of coal as a single source of supply instead of carefully separating

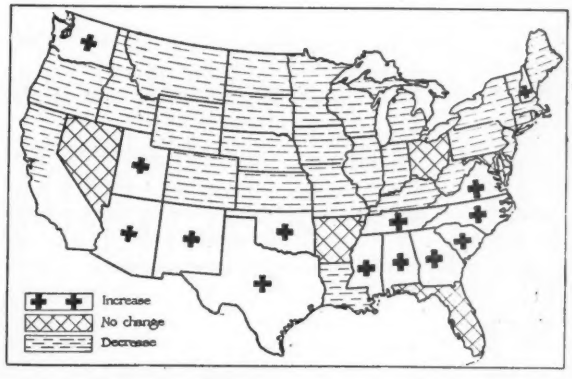


FIG. 7. INCREASE OR DECREASE IN WEEK'S SUPPLY OF BITUMINOUS COAL TO RETAILERS FROM MARCH 1, 1920, TO JUNE 1, 1920

them, as is the usual practice of the trade. Production during the past five weeks has been as follows, in net tons:

Week of Aug. 14	13,613,000
Week of Aug. 21	12,633,000
Week of Aug. 28	13,201,000
Week of Sept. 4	12,255,000
Week of Sept. 11	11,112,000

Operating Conditions During the Week Ended September 4

The week ending Sept. 4 was marked by absence of labor disturbances and by a slight reaction in the progress recently made toward improved car supply at the mines. Labor Day did not come until the following week, but in the reports from some districts there was evidence of a tendency to lay off work on Saturday, Sept. 4, in anticipation of the holiday.

TABLE II. TIDEWATER BITUMINOUS COAL SHIPMENTS AUG. 29 TO SEPT. 12, 1920

(Figures expressed in weeks and days at current rate of consumption at time of stock taking.)

	Oct.1 1916	Oct.1 1917	July 15 1918	Oct.1 1918	Nov.11 1918	Jan.1 1919	Apr.1 1919	Mar.1 1920	June 1 1920
By-product coke plants.....	No data	No data	4-0	4-4	5-0	4-4	3-2	2-1[a]	1-1[a]
Steel plants...	3-4	3-6	3-6	6-3	6-3	6-0	5-0	1-2[a]	1-4[a]
Other industrials...			6-6	10-1	10-1	9-2	6-5	3-6	3-3
Artificial gas.	No data	No data	10-2	12-0	12-1	11-4	8-2	4-3	3-1
Other public utilities...	No data	No data	4-3	5-6	6-2	7-1	7-1	3-0	3-1
Coal dealers...	No data	No data	2-1	4-0	5-2	5-4	3-4	1-6	1-3
Railroad fuel..	2-6	2-4	3-4	4-1	4-3	4-6	No data	1-4[a]	1-3[a]
Total	(b)	(b)	4-3	6-1	6-3	6-0	4-3	2-4	2-1

a Estimated from incomplete data, subject to revision. b Data incomplete. Probably 3-1 for 1916 and 3-0 for 1919.

Losses attributable to labor in that state declined from 56.1 to 4.6 per cent. In Kansas, also, a reduction in the labor loss occurred—from 10.0 to 3.6 per cent.

In the East, no change occurred in the long-drawn contest over the attempt to unionize the Kenova-Thacker field. The report for Alabama does not reflect the effect of the strike call which, though issued on Sept. 1, did not go into force until the following week (Sept. 6). Labor losses in that state were 18.2 per cent.

No sign of lack of demand in any part of the country was disclosed by the reports. Even in the Northwestern fields where, until recently, no market has been a cause of losses ranging from 1.1 to 5 per cent of capacity, not a mine reporting was closed down for lack of demand.

Transportation disability, reported by the operators as car shortage, became again overwhelmingly the dominant factor limiting production. Losses attributed to transportation averaged 27.4 per cent over the country as a whole, three times as much as the loss due to labor shortage and strikes, and more than twice the loss occasioned by all other causes combined.

The increase in the loss attributed to car shortage was in part real, in part apparent only. The average for all mines reporting rose from 24.4 per cent to 27.4 per cent. The return of the striking Indiana daymen to work increased the demand for cars and made more

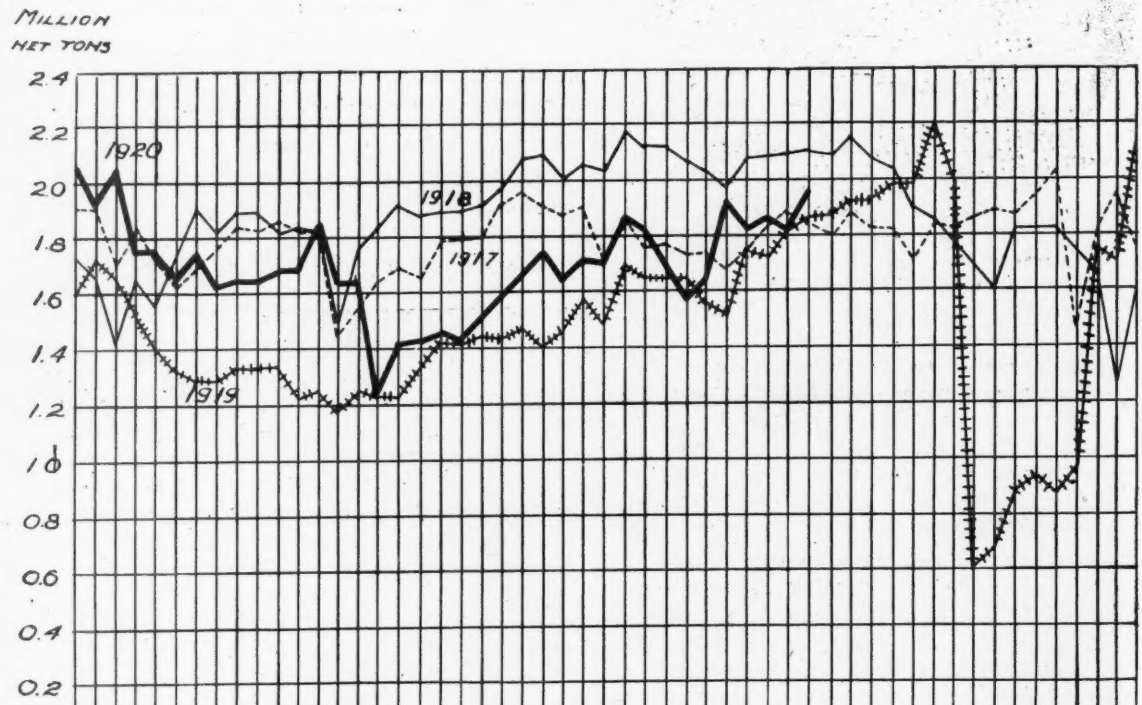


FIG. 8. ESTIMATED AVERAGE TOTAL PRODUCTION PER WORKING DAY OF BITUMINOUS COAL, INCLUDING COAL COKED

For the first time since the week of July 17, no strikes of magnitude occurred in the Middle Western field. The return to work of the Indiana daymen, which had been a feature of the preceding week, marked the close of the second phase of the daymen's strike. apparent the existing shortage. On the other hand, in several districts there was a real change for the worse. Chief among them were northern and central Ohio and the Cumberland-Piedmont-Somerset region. Other districts in which the shortage became more acute were

southern Ohio, the Hazard field, and the New River district.

A change for the better was apparent in the reports from western Pennsylvania, northern West Virginia, the high volatile fields of southern West Virginia, and southeastern Kentucky. In Illinois and western Kentucky the situation underwent no change.

West of the Mississippi reports of car shortage continued to be received from Kansas, Arkansas and Colorado.

Lake Shipments

The Labor Day holiday cut heavily into both dumpings at the lake ports and shipments from the mines for lake account. The total tonnage dumped into vessels at Lake Erie was 884,989 tons, a decrease of 189,767 tons, or 18 per cent. As no coal was handled on Labor Day the average for the remaining days of the week was much the same as during the week preceding.

	Cargo coal	Vessel fuel	Total dumped
Week of Aug. 7.....	795,969	36,732	832,701
Week of Aug. 14.....	952,298	42,127	994,425
Week of Aug. 21.....1,048,226		42,011	1,090,237
Week of Aug. 28.....1,227,039		51,026	1,278,065
Week of Sept. 4.....1,035,372		39,384	1,074,756
Week of Sept. 11.....	847,161	37,828	884,989

The cumulative lake movement from the opening of the season now stands at 12,969,000 tons, as against 19,255,000 in 1918, and 17,255,000 in 1919. The year 1920 is thus six and a quarter million tons behind 1918 and four and a quarter million behind 1919.

Loadings at the mines for shipment to the lakes under Service Order No. 10 inereased slightly over the preceding week in spite of the small movement on Labor Day, when a total of 560 cars was reported. The present week—Sept. 13-18—started off with daily loadings well above the prescribed average of 4000 cars.

The number of cars on hand awaiting dumping at the ports on Sept. 16 was 7318 as against 8554 on Sept. 9, and 7757 on Sept. 3.

Weekly Movement to Tidewater

Total dumpings at tidewater during week ended Sept. 11 were 22,328 cars, as compared with 25,275 cars for the preceding week. The decrease was largely due to the observance of Labor Day. At the southern ports practically no coal was dumped on that day. At New York, the Labor Day dumpings were about half normal; at Philadelphia, they were above normal. The average during the rest of the week was slightly below that for the month of August.

The destination of the coal dumped at tide during the last two weeks is shown in Table II. Shipments to New England were 309,000 net tons in the week of Sept. 4, and 261,000 tons the following week.

August, 1920, established a new record for the tidewater movement. The total dumped at the four North Atlantic ports and Charleston is reported to the Geological Survey by the Tidewater Bituminous Coal Statistical Bureau as 5,352,000 net tons, an increase over July, hitherto the maximum, of 437,000 tons. Shipments of cargo coal to New England increased slightly, amounting to 1,048,000 tons. There was a marked increase in the local tonnage at the ports and in that for coastwise destinations other than New England. Exports rose to a new record, 2,295,000 net tons.

Rail Shipments to New England

A recovery during the week of Sept. 11 again carried the movement of bituminous coal through the New England gateways above the level of 1919. The total forwarded through the five Hudson gateways of Harlem River, Maybrook, Albany, Rotterdam, and Mechanicsville, as reported to the Geological Survey by the American Railroad Association, amounted to 5044 cars. This was an increase over the preceding week of 588 cars, but was still much below the average for August.

Horizontal Tubular Boiler Settings and Details of Installation

Describing Details of Construction, Together with Proper Manner of Installing Usual Piping and Fittings

ALTHOUGH MANY of the features of the boiler settings described below apply equally well to the design of settings for other types of boilers, this description is concerned primarily with hand-fired, horizontal tubular boilers using coal for fuel, and is written from that viewpoint.

Wall Construction

There are a number of outside wall constructions for boiler settings each of which possesses advantages and it is left to the owner to make his choice between the designs. These are shown in Fig. 1. An older design, shown by Type I, involves the construction of two separate brick walls, bonded solidly together for a distance of about 16 in. at the top and bottom, but separated by an air space 2 in. wide for the remainder of the height. It is thought by many people that this air space acts as a heat insulator, but such is not the case; experiments by the Bureau of Mines have shown that a wall of this type will transmit just as much heat under given conditions as a solid wall of the same total thickness. As regards air leakage into the furnace, however, the double wall with air space has a distinct advantage over the solid wall shown by Type II because the cracks will occur principally in the inner wall, leaving the outer wall intact. With a solid wall, the cracks will extend clear through the brickwork, thus greatly increasing the probability of air leaks and thereby decreasing the efficiency on account of excess air. Not long ago, we had occasion to make an examination of a solid wall setting which had been built in the same boiler room with two older settings of the air-space type. Although the new setting had been in use only a few months the test with a candle flame showed more leaks than were found in the other settings which had been used several years. Of course such a test is not entirely conclusive, since there are other features which should be considered, but we believe it gives a fair indication as to what may be

expected in the average case. In constructing setting walls with an air space, it is advisable to insert a few ventpipes as indicated in the cut, these pipes being especially desirable if the bricks contain much moisture when they are laid. After the setting has thoroughly dried out, all ventpipes should be permanently sealed so as to prevent air leakage into the setting and heat radiation from the inner wall.

Type III, in Fig. 1, makes use of insulating bricks to reduce the amount of heat that is transmitted through the wall and thereby lost. These insulating bricks have little mechanical strength in themselves so that it is best to use metal ties, as shown in the cut, for bonding the inner firebrick section to the common brick on the outside. It is also advisable to use a uniform thickness of 9 in. for the firebrick lining in place of the 4½-in. lining with headers as shown for the other types. This

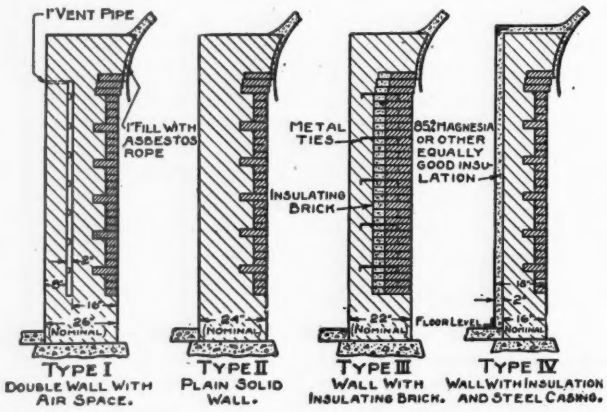


FIG. 1. DIFFERENT TYPES OF CONSTRUCTION FOR SETTING WALLS

type of construction makes a very good setting, costing somewhat more than either Type I or II.

Type IV is similar to Type I, with a steel casing substituted for the outer wall and the air space filled with magnesia or other good insulating material. This makes an excellent form of setting and reduces the heat losses to a minimum. It presents a very neat appearance and requires less space than any of the other types illustrated. Number 8 U. S. gage steel plates should be used for the casing with angle irons placed about 3½ ft. apart along the sides and back with similar angles at the top, bottom and corners.

Division Walls Between Boilers

For the division walls between boilers set in battery, the style of construction shown in Fig. 2 is satisfactory, regardless of what type of construction is used for the outside walls. The vertical slot shown in the center of the wall does not indicate an air space, but is intended to show that the two walls should be built separately and not bonded together in the center. This is to make allowance for expansion when there is a fire on only one side of the wall.

The sections in Fig. 1 apply to the side walls at the rear of the bridge wall. For the furnace section in front of the bridge wall, it is advisable that the walls be battered from the grate level to the closing-in line near the middle of the boiler shell. A reference to Fig. 2 will make this point clear. The section at the left shows the battered wall, while that at the right shows the straight form which can be used back of the bridge wall. This figure shows sections for the division wall between boilers, but the same idea should be applied to the outside walls.

In constructing side walls and division walls, it is a good idea to build an arch in the firebrick lining at a height of about 3 ft. above the grates, as illustrated in Fig. 3. When it is necessary to replace firebrick, this arch supports the brickwork above and prevents it from falling down.

For construction like that shown in Types I, II and IV, where the firebrick lining is only 4½ in. thick, headers should be used for every fifth course or even more frequently. In order to make the joints between bricks as thin as possible, a trowel should not be used, but the bricks should be dipped in thin fire-clay and then rubbed into place so as to make "brick to brick" joints.

Allowance for Expansion and Prevention of Air Leaks

Ample provision should be made throughout to allow the boiler and the setting to expand without cracking the brickwork or opening up places where air can leak into the setting. If the brickwork is built tight up to the boiler shell at the closing-in line, cracks are sure to develop when the boiler is heated up. It is best, there-

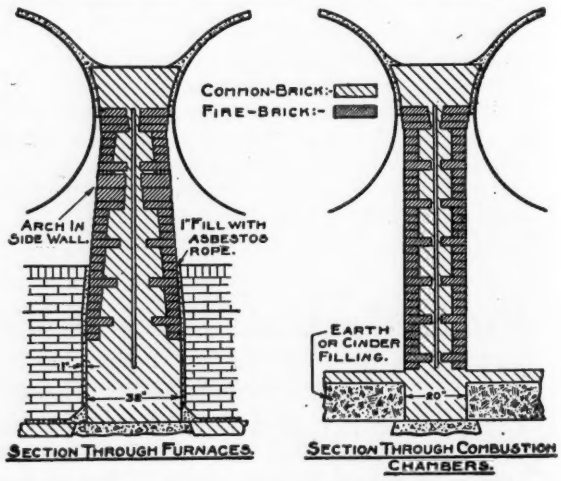


FIG. 2. DIVISION WALLS BETWEEN BOILERS SET IN BATTERY

fore, to leave the brickwork about an inch away from the boiler and fill this space with asbestos rope or some such material, as illustrated in Fig. 1. In a similar way, the brickwork and the ironwork of the boiler front should be kept about ¾ in. away from the boiler shell (and concentric therewith) and this space should be filled with asbestos rope.

To prevent cracking, due to endwise expansion of the wall, it should be built separately from the side walls, leaving a space of about 1 in. at each end. This space also should be filled with asbestos rope.

At the rear end of the boiler, a space of about 1½ in. should be left between the boiler head and the brickwork; this space can best be sealed against air leakage by extending the insulating covering down over it, as

shown in Fig. 3. There is a tendency for the covering to crack open at this point as the boiler expands and contracts, but this difficulty can be largely overcome by the use of a piece of sheet iron, formed to fit over the rear end of the boiler shell and bent down over the head to extend out on top of the brickwork. The use of an insulating covering is to be preferred for the boiler top instead of brick arches which are sometimes used.

The loss due to excess air is generally greater than that from any other cause in hand-fired boilers of the type under consideration and it is also the most difficult to prevent because it is such an intangible sort of a thing that the fireman cannot be made to realize its importance. There are several different paints and coatings on the market which can be used to good advantage in the prevention of air leaks.

Protection of Blowoff Pipes

The proper protection of the blowoff pipe is an important feature in connection with any setting for a horizontal tubular boiler. A simple pipe sleeve around the blowoff pipe is not satisfactory because such a sleeve cannot be removed for inspection of the blowoff pipe, without disconnecting the blowoff pipe itself. Split sleeves are better, and there are several patented styles of coverings available which give good results as a rule. Except under extraordinary conditions, the method of installation shown in Fig. 3 provides ample protection for blowoff pipes. The principal features of this method are a V-shaped pier of firebrick, and the location of the elbow in a covered trench.

Arch-bars

Except for large boilers, only two arch-bars are needed for a single setting. These bars extend transversely of the setting, spanning its width and bearing upon the side walls. They should be set so as to leave a full, free opening through all the tubes, with proper provisions for inspecting and removing the fusible plug, but, at the same time, care should be taken that no part of the head above the lowest permissible water level is exposed to the heat.

Height Above Grates

The combustion volume, and therefore the height from grates to boiler shell, should be varied in accordance with the character of the fuel used, more volume being required for fuels containing a large proportion of volatile matter than for those which contain a relatively greater percentage of fixed carbon.

For a 72-in. boiler with tubes 18 ft. long, it is recommended that the following heights be used:

For anthracite coal and semi-bituminous coals containing less than 18 per cent of volatile matter, 36 in.

For bituminous coals containing from 18 per cent to 35 per cent of volatile matter, 40 in.

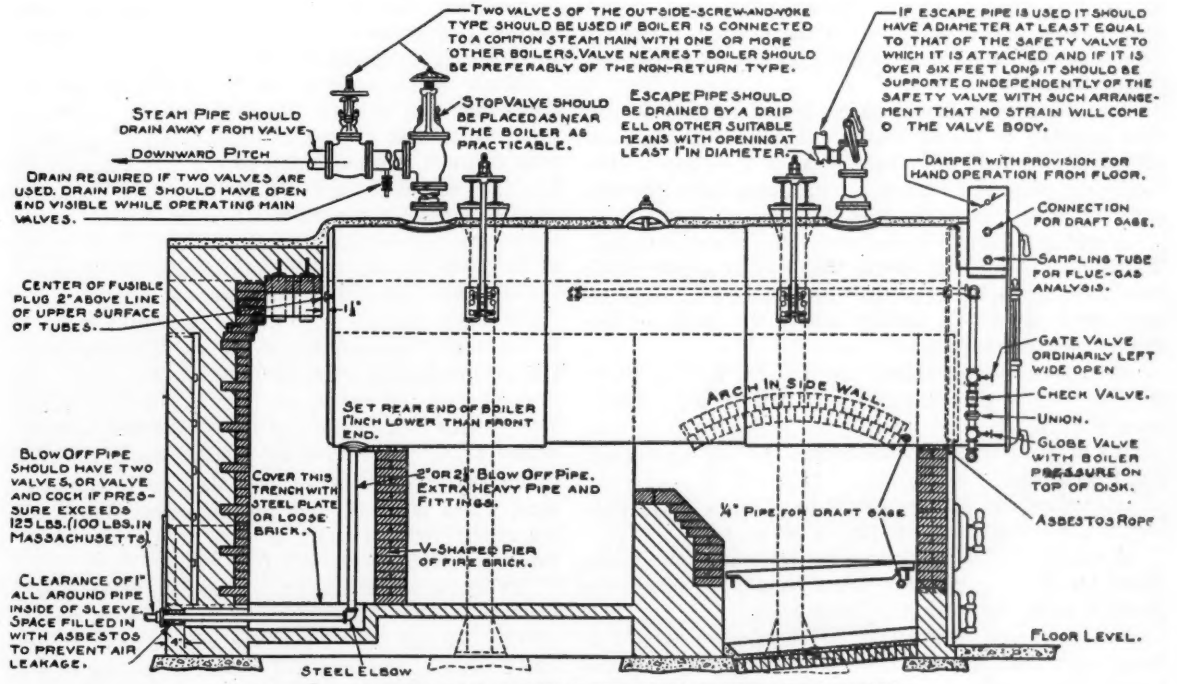

TWO VALVES OF THE OUTSIDE-SCREW-AND-YOKE TYPE SHOULD BE USED IF BOILER IS CONNECTED TO A COMMON STEAM MAIN WITH ONE OR MORE OTHER BOILERS. VALVE NEAREST BOILER SHOULD BE PREFERABLY OF THE NON-RETURN TYPE.
IF ESCAPE PIPE IS USED IT SHOULD HAVE A DIAMETER AT LEAST EQUAL TO THAT OF THE SAFETY VALVE TO WHICH IT IS ATTACHED AND IF IT IS OVER SIX FEET LONG IT SHOULD BE SUPPORTED INDEPENDENTLY OF THE SAFETY VALVE WITH SUCH ARRANGEMENT THAT NO STRAIN WILL COME ON THE VALVE BODY.
STEAM PIPE SHOULD DRAIN AWAY FROM VALVE
DOWNWARD PITCH
DRAIN REQUIRED IF TWO VALVES ARE USED. DRAIN PIPE SHOULD HAVE OPEN END VISIBLE WHILE OPERATING MAIN VALVES.
STOP VALVE SHOULD BE PLACED AS NEAR THE BOILER AS PRACTICABLE.
ESCAPE PIPE SHOULD BE DRAINED BY A DRIP ELL OR OTHER SUITABLE MEANS WITH OPENING AT LEAST 1 IN DIAMETER.
DAMPER WITH PROVISION FOR HAND OPERATION FROM FLOOR.
CONNECTION FOR DRAFT GAGE.
SAMPLING TUBE FOR FLUE-GAS ANALYSIS.
CENTER OF FUSIBLE PLUG 2" ABOVE LINE OF UPPER SURFACE OF TUBES.
GATE VALVE ORDINARILY LEFT WIDE OPEN
CHECK VALVE.
UNION.
GLOBE VALVE WITH BOILER PRESSURE ON TOP OF DISK.
ARCH IN SIDE WALL.
SET REAR END OF BOILER 1 INCH LOWER THAN FRONT END.
BLOW OFF PIPE SHOULD HAVE TWO VALVES, OR VALVE AND COCK IF PRESSURE EXCEEDS 125 LBS. (100 LBS. IN MASSACHUSETTS)
COVER THIS TRENCH WITH STEEL PLATE OR LOOSE BRICK.
2" OR 2½" BLOW OFF PIPE, EXTRA HEAVY PIPE AND FITTINGS.
¼" PIPE FOR DRAFT GAGE
ASBESTOS ROPE
V-SHAPED PIER OF FIRE BRICK.
CLEARANCE OF 1" ALL AROUND PIPE INSIDE OF SLEEVE. SPACE FILLED IN WITH ASBESTOS TO PREVENT AIR LEAKAGE.
FLOOR LEVEL.
STEEL ELBOW

FIG. 3. LONGITUDINAL SECTION THROUGH CENTER OF SETTING

For bituminous coals containing more than 35 per cent of volatile matter, 44 in.

For other sizes of boilers, the figures are varied so as to maintain approximately the same ratio of combustion volume to grate area.

Method of Support

When boilers are suspended in battery it is best to place the supporting columns entirely outside of the setting walls, using only four columns with beams of sufficient strength to support the boilers in a single span. With standard I-beams it is possible to support in this manner three boilers of any diameter not exceeding 78 in., or two boilers of large diameter. If the installation involves more boilers it is best to set them in separate batteries of two or three boilers each, rather

than to use columns in the division walls between boilers. If it is absolutely necessary to use such intermediate columns, an air space should be left all around each one with a suitable ventilating duct to admit air at the bottom. There have been cases where columns have been burned off when built solidly into setting walls.

Boilers having a diameter of 78 in. or less can be supported by brackets which rest upon bearing plates built into the setting walls, but the suspension method is better, particularly for the larger sizes. Four brackets (two on each side) are sufficient for boiler diameters of 54 in. or less; but eight brackets should be used for boilers larger than this size, the brackets being located in pairs with a single bearing plate for each pair. Brackets at the front end should rest directly upon the plates, but rollers should be used under the brackets at the rear end to permit free expansion of the boiler.

INSTALLATION OF BOILER PIPING, VALVES, FITTINGS, ETC.

SELF-EXPLANATORY notes will be found on the drawing, Fig. 3, relative to the proper installation of piping, valves and details. In addition, the following details should receive attention in any well-planned installation.

The steam gage should be graduated at least 50 per cent in excess of the maximum allowable working pressure and it should be piped up with a siphon, union cock, drip cock, and connection with stop valve for test gage, brass fittings being used throughout.

A water glass and three gage cocks should be used. The lowest visible part of the water glass should be at least 2 in. above the center of the fusible plug and the gage cocks should be located within the range of the visible length of the glass.

A blow-down pipe should be provided for the water column with a gate-valve or cock. This pipe should have a diameter of at least ¾ in. and should be connected to the ash pit or some other safe and convenient point of waste.

All valves and fittings should be of extra heavy pattern if the pressure exceeds 125 lb. per sq. in.

A sampling pipe for flue gas analysis and three ¼-in. pipes for draft gage connections should be placed in position when the setting is being built.

The foregoing description is intended to cover the more important features connected with the construction of brick settings for horizontal tubular boilers and the installation of such boilers in accordance with good practice, but without any unnecessary frills.

These plans were prepared by the engineering department of the Hartford Steam Boiler Inspection and Insurance Co., and described in The Locomotive, to whom credit is extended for this abstract.

Great Western Power Plants to Double Present Capacity

BY CHARLES W. GEIGER

BY THIS fall the Great Western Power Company of California will have installed 185 mi. of the highest voltage transmission line in the world, running from Caribou, on the north fork of the Feather River, to San Francisco. When the company starts the first two units of its second power station shortly after the first of the year, it will have in operation at the plant four of the largest water wheels ever made, making a total of 140,000 hp., as compared with 86,000 hp. at present. The Caribou or second plant is now 75 per cent complete. Besides the two plants the company owns sites, land and water rights for five more plants, facilities for the largest artificial lake in the world and water for 640,000 hp. of electrical energy, which should make it the largest producer of hydroelectric power in California.

Many millions of dollars have been spent on the construction work and much more is contemplated. In the work of construction numerous engineering difficulties were encountered and successfully overcome. For the hauling of material to the Caribou plant, it was necessary to construct 9½ mi. of standard gage railroad through the mountains, which, with a switchback containing 750,000 ft. of timber, cost $500,000, or approximately $50,000 per mile. Besides this, it was necessary to construct three surface tramways and two lines of narrow gage railways for the carrying of material to the different camps and dams.

Much of the work of the old placer miners of the early days was utilized. The famous old Caribou trail was used at first to pack in supplies and later the railroad followed it considerable of the way. An old ditch line that was used for hydraulic operations in the early days was used for a flume in Butt Valley to run a temporary power plant for construction work. On top of the flume is constructed considerable of the 8 mi. of narrow gage railroad in Butt Valley.

In Lake Almanor, one of the largest artificial lakes in the world, formerly known as Big Meadow, there are springs producing about 800 sec. ft. of water. There is a water shed of 504 sq. mi. tributary to Lake Almanor. The present capacity of the lake is 300,000 acre-ft. It covers 15,500 acres with an average depth of 19½ ft.

In the gorge south of Big Meadow is situated the dam, which is 92 ft. high and measures 600 ft. across the crest. At this point, it is 80 ft. thick, and at the base the thickness is 600 ft.

By increasing the height of the dam 18 ft. it will be possible to store 1,250,000 acre-ft. of water, while the average annual run-off into the lake is 842,000 acre-ft. The raising of the dam will allow the storing of all the run-off and allow the company to regulate the flow of water throughout the year. By this means a steady flow can be assured through dry and wet seasons and storage can be made for a period of years.

As the Great Western owns the power sites along the Feather River, it can run the water through all its plants for power purposes and then sell the surplus water. This is done through subsidiary organization to the farmers and guarantees a steady flow throughout the year in spite of seasonal conditions.

At the No. 1 tunnel, which connects the Butt Valley and the Big Meadow water sheds, two 7-ft. electrically controlled gates will be installed at the intake. This tunnel will be 11,400 ft. long. From camp No. 3 the tunnel has been driven in over 2000 ft., while a considerable distance has been driven from the lake end. There are also three shafts down to the tunnel level and headings are being driven both ways. Some difficulty has

been encountered with the water, but this has been overcome and the work in the big bore is now 50 per cent completed. This tunnel is not needed at once as the water from Butt Valley will be sufficient to run the Caribou plant.

From the outlet of the tunnel the water flows down the valley to the Butt Valley dam, 8 mi. below. The present dam is 30 ft. high. The capacity of the forebay is 1000 acre-ft. By raising the dam 104 ft. the capacity may be increased to 105,000 acre-ft.

From the forebay, the water will enter the last tunnel, which is being constructed in sections. This has a diameter of 9 ft. and a capacity of 1000 sec. ft. The lower end of the tunnel has a slope of 37 deg. from the horizontal and in its course from Butt Creek has a fall of 1140 ft. to an elevation above the water wheels where it empties into horizontal penstocks, running a distance of 300 ft. At the wheels the water will have a pressure of 440 lb. per sq. in.

A short distance above the plant is a large vertical surge chamber for relieving the pressure and a short distance below this will be the chamber for supplying the pipes running to the water wheels. Four 42-in. pipes will be installed at once for the first two units of the Caribou plant. This will be completed about Feb. 1, while the tunnel work will be completed by the latter part of November.

The foundation is now in at the Caribou power house, and the reinforced concrete work above is well under way. The first unit will have four water wheels of 15,000 hp. each. They are the largest of their kind in the world.

As soon as the electric current is turned on at the Caribou plant next year the company will be supplying 140,000 hp.

The Great Western project is probably one of the most compact in the West. Although it extends for a considerable distance along the Feather River, the abrupt decline of the river allows the using of the water for power purposes again and again.

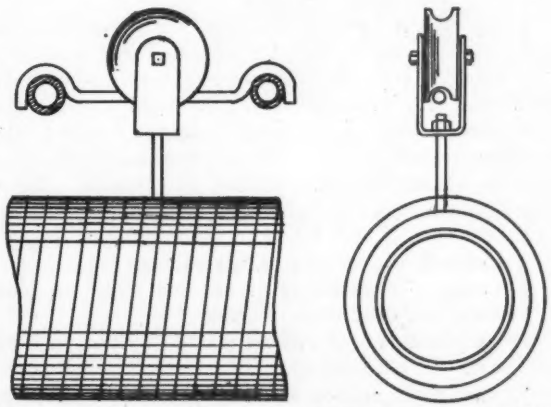
Some Notes on Pipe Covering

By Charles L. Riecke

MANY articles on pipe covering have been published in the past, notable among which is one, "A Catechism on Heat Saving," by Austen Bolam, in the Aug. 1 issue, which is excellent although no specific reference is made to covering other apparatus about the plant aside from piping, boilers and exposed surfaces. The latter no doubt is intended to include everything not mentioned. I have found it advantageous to cover steam traps when the type and operation of the trap makes this possible.

Feed water heaters should also be covered when possible and the steam cylinders of pumps and compressors can, in most cases, be covered with good results by applying plastic asbestos as thick as possible and covering this with a metal or well-seasoned hardwood lagging drawn close with light iron bands. Of course, this can be carried to extremes where the results attained do not justify the outlay; but in the matter of treating pumps, heaters, traps, etc., the outlay is small and the heat saving remarkable. Many engineers treat the matter of covering all too lightly and do not consider an examination of the covering under their care at all necessary, simply going from one plant to another and operating them as they find them and leaving them in much the same condition. We all know that there are many plants in which pipe covering is an unknown quantity and all efforts of engineers in charge to convince the owners of the importance of good covering have met with defeat; in other plants, it is at once evident that the engineers in charge do not care how much of their piping remains exposed or is badly covered. In one place, I encountered a 2½-in. steam line which ran for a distance of about 300 ft. out in the open, uncovered and supported about 10 ft. above ground on wooden frames; this line supplied steam to pumps on a river bank and the condensation was so great that the pet cocks on the cylinders of these pumps had to be kept open at all times to free them of water and prevent cylinder heads being knocked out. I was told that this line had operated in that condition for several years.

I also have in mind a pipe line 4 in. by 338 ft. with three expansion joints which was installed 29 yr. ago and was placed in a brick-lined trench 2 ft. wide by 4 ft. deep; about midway between the top and bottom of this trench, short pieces of pipe were imbedded in the brick work and on this pipe the steam line was laid, while down on the bottom of the trench ran a return line from the heating system and alongside of the steam line a 4½-in.



MANNER OF SUSPENDING STEAM LINE IN ORDER TO INSURE AMPLE PIPE TRAVEL

exhaust pipe was run and the whole trench filled with sawdust and covered with 2 by 12-in. planks with no provision to keep out the rain water. Consequently, in wet weather a fog of vapor kept continually rising from this "plank walk," as it was called, and there was always an abundance of hot water in this line from which several pumps and small engines were served with what efficiency can well be imagined; after leaving the trench, the line ran under the floor of the main building and at

its lowest point a trap was working overtime in the vain endeavor to carry off the excessive condensation, with the consequence that its valves and seats were completely cut out every few weeks.

Continuing under the building, the pipe was not covered for a distance of 50 ft., then a fairly good covering continued for a short distance and then some hair felt was wrapped around the pipe and tied with twine, and as both hair felt and twine had dried out, simply hung over the pipe very much like a blanket when flung over a horse. In this way, the line continued to the end of a 500-ft. run with all branches exposed.

It was the work of the writer some years ago to remove all pipe from this trench, doing away with the exhaust pipe and also the return on the bottom, and to install a new steam line of a 4-in. wrought iron pipe; before doing this, however, the trench was connected to a terra cotta drain to take away water which entered during rainy weather. While this work was going on, a well-known manufacturer of pipe coverings was consulted and given a thorough understanding of just what service would be expected of the covering and the conditions under which it would have to serve and without any "shopping round" the manufacturer was given *carte blanche* and his suggestions carried out as follows: After running the line with one double expansion joint midway, anchored to a brick pier and each end of the line in the trench anchored so that all expansion would be toward the joint, we began with a fire felt covering in sections and 1 in. thick and with the joints between the sections well sealed with plastic asbestos. Over this first course another was placed in the same way, but with joints "broken" and likewise filled with asbestos, then two courses of asphalt laid roofing were imbedded in hot Trinidad asphalt around the covering, lapping and at the same time "breaking" all joints. When cool, the whole was securely wrapped with small galvanized wire 3 in. between the turns and then given a heavy coating of coal tar. This pipe was suspended on roller hangers which take care of the movement caused by expansion and contraction. Since this change was made, we have had no condensation trouble, a very small trap taking care of the little which naturally will accumulate and our fuel consumption has been reduced considerably. That part of the line running under the building was similarly treated with the exception of applying asphalt and roofing and the whole is as good in appearance as it is efficient in operation.

When covering separators and receivers, a good job can be made by covering first with poultry netting to which plastic asbestos can easily be applied about 2 in. thick and well smoothed down and the whole covered with 1/16-in. asbestos paper and the usual bands applied when it can be painted or given a coat of kalsomine in any desired color in keeping with the other parts of the engines. While the main object sought after is economy and efficiency, the appearance of the completed job should be pleasing to the eye and with a little thought and care just such results will be attained. The accompanying sketch shows the manner of suspension of the 4-in. steam line providing for the movement of the pipe in both directions.

New Mechanically Operated Gas Producer

PRODUCER EMPLOYING NOVEL METHOD OF AGITATING FUEL BED GENERATES CLEAN, COLD GAS

ONE OF the essential requirements possessed by a gas for use in gas engines or for distribution through a system of piping is that it should be free from heavy or viscous tar. To produce such a gas it becomes necessary to incorporate in the design of the generator certain features which research and practical experimentation have shown must be provided. These may be enumerated as follows:

1. A deep fuel bed, 4 to 5 ft. thick.
2. Uniform distribution of air to fuel bed.
3. Constant proportions of air and steam in blast under all conditions of load.
4. Moderate rate of gasification to produce pure tar with no lampblack.
5. Ease of inspection and manipulation, without escape of obnoxious gases.

These requirements have been successfully fulfilled in the design of the Smith Gas Engineering Co.'s latest contribution to the art of building gas producers; the Smith type "G" mechanically operated installation for the generation and delivery of clean, cold gas.

There are several types of mechanically operated gas producers on the market in which the fuel bed is manipulated or agitated in a variety of ways. These, however, are designed to deliver the gas hot or "raw" at the point of application, are generally steam blown and practically never carry a fuel bed more than 24 in. thick; are usually driven at high rate of gasification, operate at high temperatures, and produce a gas which contains a heavy tar, most difficult to remove when it becomes necessary to clean the gas. Within the very restricted field of hot gas application these machines have their sphere of usefulness, but when producer gas is to be used in gas engines, it becomes necessary to design a gas generator especially for the work.

Because of the conditions now prevailing in the labor and fuel markets, it has been found necessary to develop a producer in which the fuel is mechanically distributed evenly over the bed, in which the previously hand-performed stoking and poking is accomplished automatically and in which fuels of rather widely varying compositions and firing characteristics can be successfully gasified.

The engineers of the Smith Gas Engineering Co., adhering to the basic principles which have been established in actual service under a wide range of operating conditions, have evolved to meet the foregoing basic requirements in the type "G" mechanically operated producer, a machine incorporating all of the fundamental requirements together with the additional features called for by the conditions existing today. The first of these machines was put into operation more than a year ago, others have been installed since, and several large units are being built at the present time. Those

in commercial operation have been under close observation continuously, and have proved successful to the highest degree.

The use of clean, cold producer gas in industrial heating operations is daily becoming more extensive, and in many cases this fuel is proving its reliability and economy in fields where hot gas has formerly held sway.

Necessity for Thick Fuel Bed

In a producer which is to deliver gas that may be cleaned, a deep fuel bed is necessary to effect the slow distillation of the coal required if the production of viscous tar and lampblack is to be avoided. Ordinarily the gas-making zone in a producer extends about 16 in. into the fuel bed. The temperature of the gas leaving this zone will obviously be the temperature of the zone itself. If the fuel bed is 5 ft. deep, as is usual practice in Smith producers, the hot gases must pass through 3½ ft. of descending fuel which absorbs a large amount of their heat. As the gas ascends, it becomes gradually cooler, and when fresh coal is distributed over the top, the fuel is not immediately exposed to high temperatures, but instead is slowly heated. This slow heating produces the slow distillation that is so necessary. The tar produced is fluid and easily removed from the gas.

The heated fuel above the fire also provides an instantly available reservoir of coal to take care of overloads on the plant, and thus assists in securing uninterrupted gas flow. The mechanical poking feature incorporated in the Smith type "G" producer insures agitation in spite of the usual thickness of the fuel bed.

Uniform Distribution of Air and Vapor

The fuel bed is supported on cast-iron grates in such a way that the entire area of the fuel bed is exposed to the action of the air-vapor mixture. The bed is of uniform thickness and consequently there is no greater resistance to draft passage at one point than any other.

Constant Proportions of Air and Steam

The proportion of water vapor in the draft must be constant at all loads, and in the Smith system it is held constant by the application of the physical law of saturation. Air at a given temperature when saturated will contain a definite amount of water vapor. It only remains to find the temperature at which the air will contain the moisture required under known conditions, and then maintain the entering air at that temperature. Sufficient steam is provided to heat the air to the required temperature and the latter is held constant by a thermostat regulator. A thermometer is provided in order that the operator may at any time know the conditions existing.

Moderate Driving

The producers are rated moderately so that the temperatures in the hottest zone are below those required to fuse the ash. It is impossible to secure continuous operation where hard driving is necessary, because rapid firing means high temperatures, which in turn mean clinker troubles and shut-downs. The type "G" producers being designed to develop their rating at moderate gasification per unit grate area, these troubles are avoided, and continuous operation assured.

Good Operating Conditions

The successful gas generator must be designed to permit inspection and manipulation without exposing the operators to the dangers of poisonous gases. This is accomplished in the type "G" generator by operating the producer under suction so that the grate and ash pits can be inspected by opening the doors provided for the purpose. The top of the fuel bed can be inspected by opening peek holes in the producer top without permitting the escape of gases.

If the ash pit is to be open for any length of time while the producer is under load the pressure of incoming air can be balanced by the use of a steam jet or power-operated blower attached to the saturator inlet.

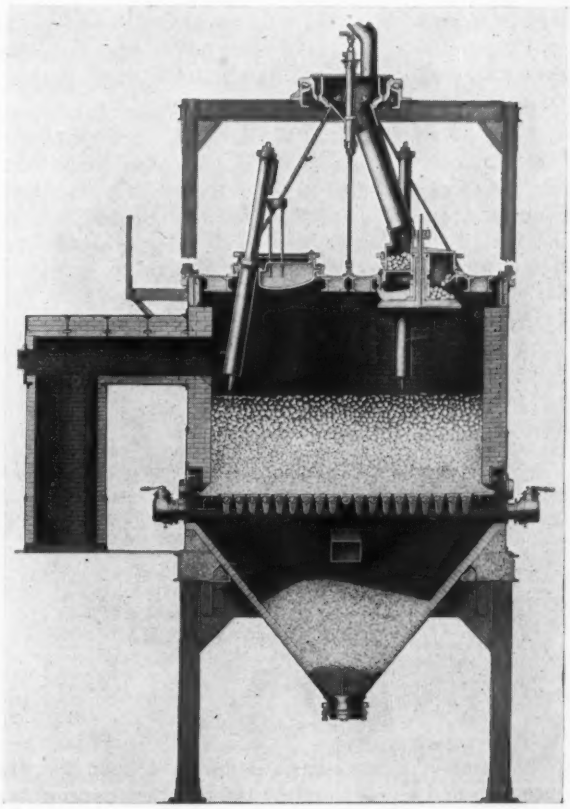


Fig. 1. Cross-section of type "G" producer

This insures saturation of the air, and the same gas-making conditions are maintained during the grate-cleaning period as in normal operation.

New and Distinctive Features of the Mechanical Poker

To those familiar with the semi-mechanically operated type MB producer, it will be recalled that the generator was built either square or rectangular in section and increased capacity was obtained by the addition of similar units. By referring to the illustration, it will be observed that the new type "G" is circular. This change was brought about to make possible the mechanical charging and poking of the generator by a simple and easily operated mechanism.

The producer top is supported by structural steel

framing and is suspended from a large roller bearing, making rotation possible with very little friction.

A water seal is provided around the top of the producer shell and sway rollers are spaced around the periphery of the rotating element to take care of any unbalanced loading or weighting of the top.

There are provided in the top two rotating turrets. Eccentrically located with respect to the generator axis and within one of these turrets is mounted a steam operated poker. The other turret contains the fuel distributing device and includes arrangements for feeding fuel in varying quantities, and for uniformly dropping the fuel over the fuel bed.

By referring to the illustration, Fig. 1, it is seen that the poker cylinder is placed on the turret eccentrically with the turret axis and also at an angle slightly off the perpendicular. When the poker is extended and in the "out" position it will reach the generator lining, and when extended in the "in" position will reach the center of the fire.

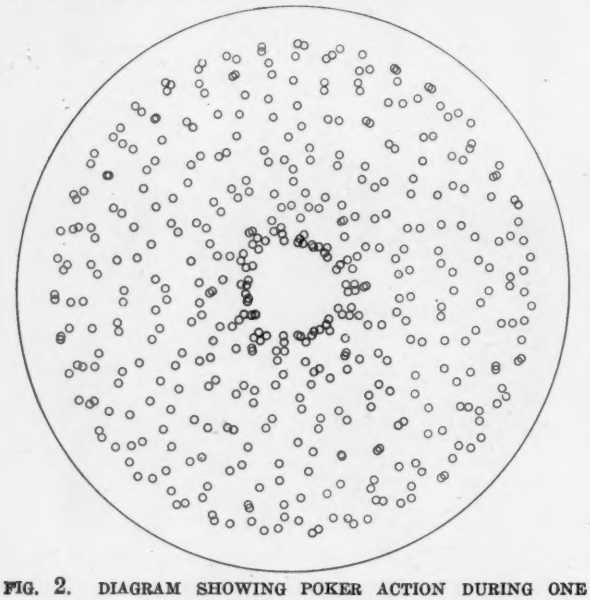


FIG. 2. DIAGRAM SHOWING POKER ACTION DURING ONE HOUR OF OPERATION

A steam-operated engine is mounted upon the producer top and serves to rotate the top, the charging turret, and the poker turret with intermittent motions by means of ratchet devices. During the "out" stroke of the turning engine, the pawls for moving the top and the poker turret engage, causing these two rotating parts to advance. On the "in" stroke of the engine, these parts are at rest and the charging turret advances.

While the poker turret and top are at rest, steam is admitted automatically to the poker cylinder, and the poker itself is forced down into the fuel bed and withdrawn in much the same manner as a man would poke the fire in a hand-operated machine. The cycle is then repeated in regular and continuous order.

The poking diagram, Fig. 2, shows how uniformly and thoroughly the mechanical poker does its work. The speed with which the cycle is completed is under the control of the operator, and the latter can engage or disengage the poker and charging turrets at will.

It should be noted that there is no dragging of the poker through the fuel bed and therefore that all side strains on the top are eliminated.

The steam-operated devices used on this machine, i. e., the reciprocating turning engine and poker, are as simple as a direct-acting steam pump and should not be thought of as complicated. The control system is complete, yet simple, and is interlocked in such a way that the whole arrangement is "foolproof."

Gas-Cleaning Equipment

THE CLEANING and cooling apparatus supplied with the type "G" machines has been thoroughly tested and perfected during the past 10 yr. of service. It consists of a primary cooler, secondary cooler, and tar extractors, together with a standard type exhauster, piping, bypass, tar trap pump and drains.

This cleaning equipment is guaranteed to remove 99.5 per cent of the tar from the gas and there are many plants in service where the cleaning efficiency is as high as 99.98 per cent.

Process of Gas Production

THE GAS on leaving the generator is conducted through a brick-lined downcomer to a primary cooler of the static type where its temperature is reduced to a degree best suited to the efficient operation of the tar extractor. The gas then passes to a low-pressure main from which it is discharged to the inlet of the gas pump.

The gas pump used in connection with this equipment is of the positive type designed to operate under a maximum pressure of 5 lb. per sq. in. The gas is delivered by the pump under a pressure sufficient to overcome the differential pressure of the tar extractor plus the pressure required on the distributing system. Power for operating this pump is furnished by a direct-connected steam engine controlled by a variable speed governor of special design which automatically adjusts the speed of the pump to meet the demand for gas.

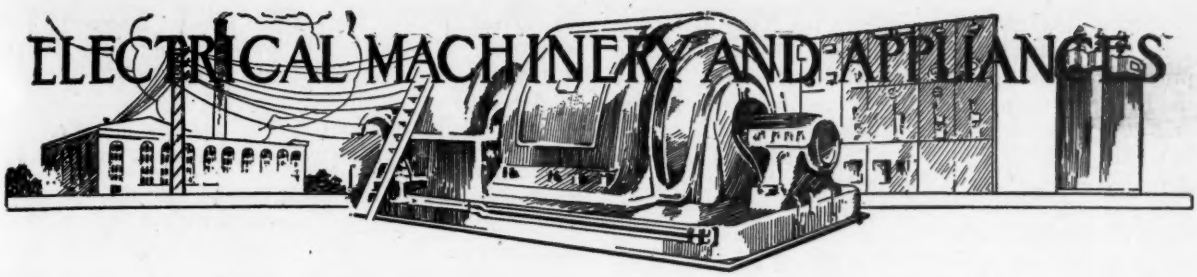
The tar extractor is extremely simple in construction, has no moving parts and requires no water in its operation. The upper housing contains a diaphragm of spun glass through which the tar-laden gas is passed at high velocity. The action of the spun glass diaphragm causes an agglomeration of the tar particles until the drops are of sufficient size to fall out of the gas current by gravity. A suitable number of housings and diaphragms are provided with each producer unit to permit of the replacing of the diaphragms without interfering in any way with the cleaning capacity of the plant.

The gas, after it leaves the air extractor, passes through a secondary cooler of the static type in order that all remaining impurities be removed and the gas temperature reduced to that of the atmosphere.

Tar Return

THE TYPE "G" machines are equipped with the necessary apparatus and piping for returning the tar from the tar-settling tanks to the top of the generator and there spraying it upon the fuel bed.

By means of this procedure a part of the tar is fixed in the gas, a part of it returns through the system in the form of tar, and a part is finally consumed in the fuel bed, the net result being a very appreciable increase in the efficiency of gas generation.



Using the Graphic Meter

AN ACCOUNT OF ITS FUNCTION AND METHODS OF INTERPRETING ITS RECORDS. BY VICTOR H. TODD

GRAPHIC instruments are those in which an inked pen draws a continuous curve or graph on a moving strip of paper, automatically plotting the value of the quantity being measured against the time of its occurrence. The paper is generally in long rolled strips ruled lengthwise with lines representing quantity and crosswise with lines representing time. The strips are several inches in width and long enough for a week's record. The paper is driven under the marking pen at a constant speed by clockwork, and the pen is deflected across the paper proportional to the quantity being measured. Figure 1 shows a section of a graphic record which will be analyzed later.

As the name implies, the graphic ammeter records the amperes flowing at any instant. A typical example of a practical, rugged, flexible and cheap graphic is

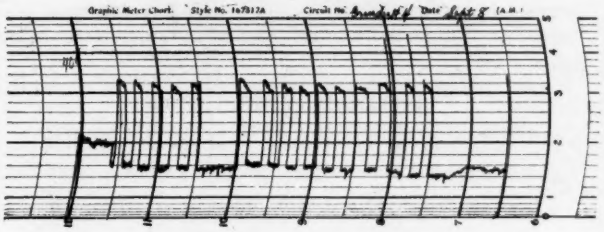


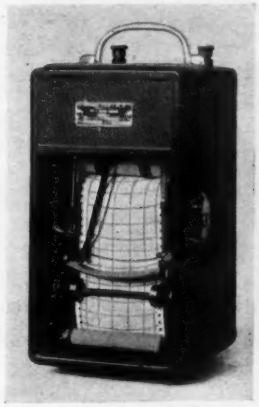
FIG. 1. SECTION OF CHART ILLUSTRATING TYPICAL INDUSTRIAL LOAD

shown in Fig. 2. This same instrument, but with cover opened, is shown in Fig. 3.

PRINCIPLE OF OPERATION

THE PRINCIPLE of operation is shown diagrammatically in Fig. 5. Soft-iron laminated plunger, A, working under the influence of solenoid, B, is attached by pivots at C, to movement, D, which carries pen arm, E, and V-shaped pen, F. The movement is pivoted at C, which allows a downward pull of the plunger to deflect the pen sidewise across the paper. The pen arm is again pivoted at H and H' to allow the pen-point to swing lightly against the paper. Solenoid, B, is wound with a few turns of heavy copper wire or strap, and carries the main current, or, when used with transformers or shunts, a current proportional to the main current. Consequently the pull on the plunger and the resultant deflection of the pointer responds to, and represents the current passing through the coil.

At the bottom of the plunger is a small piston working in a dashpot which may be filled with oil to prevent sudden surges in current from throwing the pen and spilling the ink. The deflection is opposed by a strong spiral spring. This allows such a high torque to be used that inaccurate levelling and friction of pen on paper do not introduce appreciable errors. The main roll of paper is inserted through the side of the case by removing the plug at M (Fig. 3). It is then threaded under the rollers, K, and started on the reroll spindle, L. The entire edge of the paper is perforated with equally-spaced round holes, into which the projections on rollers, K, fit accurately. As these rollers are driven



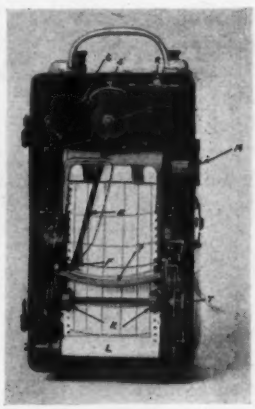


FIG. 2. A GRAPHIC AMMETER

FIG. 3. INSTRUMENT SHOWN IN FIG. 2 WITH COVER REMOVED

by clockwork, they cause the paper to move at a uniform speed. The reroll keeps the paper taut as it is driven by a slip-belt shown at N. The eight-day clock has a marine (balance wheel) escapement running in jewels.

The clock should always be wound at the beginning of each new run, or at least twice a week. The standard paper feed is one inch per hour, but sometimes 2 in. will be preferable. The one-inch rolls are 16 ft. long and the 2-in. rolls, 32 ft. long (of thinner paper), thus permitting a week's record in either case. Figure 3 shows a rear view of parts.

CONNECTING IN AND RECORDING A LIGHTING CIRCUIT

LET US assume a typical case. A lighting customer

complains that his bill is entirely too high, as he has only a few lamps burning in the evening. With a promise of investigation, the complaint clerk "stalls" the customer temporarily, telling him to return in several days. Meanwhile he requests the meter department to obtain a day's load curve. The meter man takes his graphic ammeter with a pair of quick connection leads and proceeds to the disputed circuit. The graphic is hung on a single round head screw by means of a lug provided for that purpose. It is leveled approximately, the roll of paper inserted, threaded under the pen and started on the reroll. The V-pen is filled with ink from a bottle conveniently secured in the case-cover. This is done either with a medicine-dropper or by dipping a match stick in the ink, and conveying a drop to the pen. If there is any possibility of requiring several days run, it may be well to start the ink reservoir shown

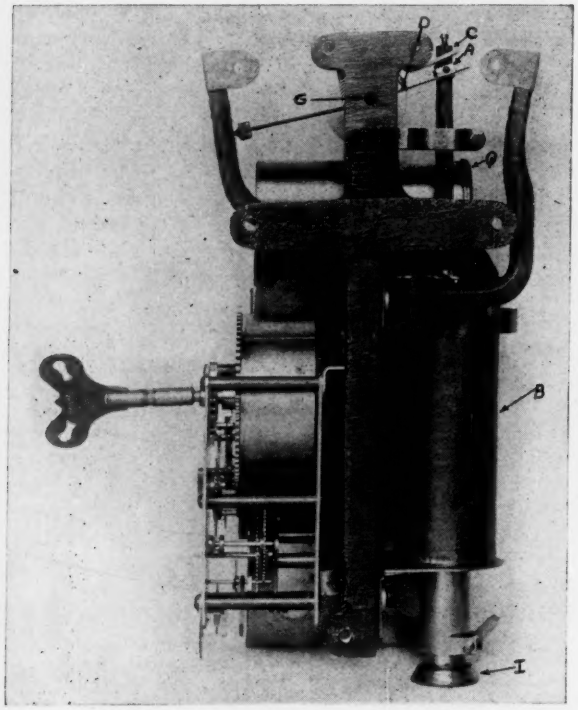


FIG. 4. REAR VIEW OF ELEMENT

at O (Fig. 3). This is filled with ink and a strand of cotton thread run through the tube and inserted in the pen. This feeds ink just like a lamp wick feeds oil: by capillary action. If previous experience shows that the ink feed is not rapid enough, the meter man will insert two or three strands. If the pen overflows, the ink will merely drop on the blotting paper at P.

The next step is to release the moving element (which has been secured for transportation) by loosening the clamp at Q with the clock key, which is conveniently held in a retaining clip at R. If the pen is slightly off zero, the thumb-screw at S may be loosened and the zero corrected.

The instrument is next connected in series with one line. This is easily done by using leads with quick connection clips, connecting to both line and load side of one fuse plug and then removing plug. This will shunt the current through the graphic without a second's interruption. If no current is flowing, a lamp or so should be turned on temporarily to see that the pen is deflecting. Then the paper is advanced or set (by loosening the nut at T) until the correct hour marking is under the pen point. Nut, T, is tightened, the clock wound and

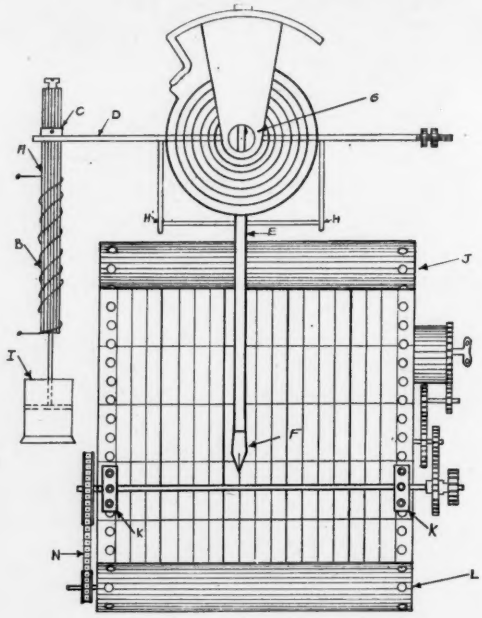


FIG. 5. DIAGRAMMATIC SCHEME OF PARTS

started, the cover closed and locked. After observing correct operation for 5 or 10 min. the meter man will leave the meter to record just what current is being used.

INTERPRETING THE RECORD

IN A DAY OR SO, he returns, removes the graphic and turns the record over to the complaint clerk. Next time

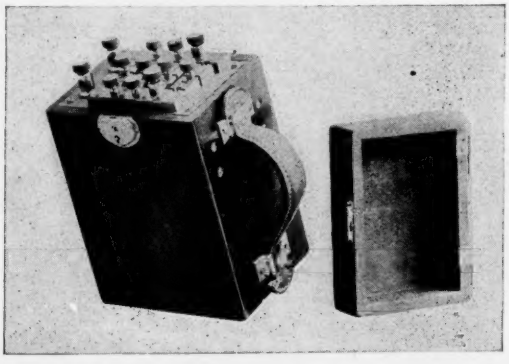


FIG. 6. CURRENT TRANSFORMER, VARIABLE RATIO TYPE

the customer returns, the interpretation of the record may be as follows. "From 9 to 12 a.m. you used an electric sad-iron." This is assumed from a record where the pen (on a 5 amp. meter) goes clear across the scale, and back to zero every 10 or 20 min, as the iron is turned on and off. Then, too, there is practically nothing else the householder will use in the morning that consumes over 5 amp. "From 12 to 5:45 p.m. there was a 60-w.

lamp burning; in fact, this is burning night and day. Undoubtedly you have a lamp lit in the cellar, or attic or a closet and have forgotten it." Care must be taken that a zero error is not interpreted this way. "From 5:45 to 6:00 p.m. you had a percolator or toaster stove in operation." This is assumed from the time of day, the steady load, and the short length of time. From then to 9:30, you burned about five lamps and you had a 60-w. hall lamp burning all night in addition to the one in the attic or closet." This does not correspond with customer's plea that he had "only a few lamps burning in the evening."

Naturally, this should settle Mr. Customer's complaint.

Of course, if a customer is intelligent enough and deceitful enough, he may not use current while the meter is in circuit. This may be not only true of the little customer using a few amperes, but also of the big customer whose bill amounts to thousands of dollars per month. The remedy in the first case is to "camouflage" the graphic by installing in an empty transformer case

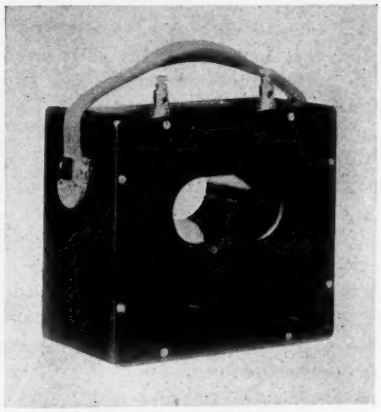


FIG. 7. THROUGH TYPE CURRENT TRANSFORMER

and hanging on a nearby pole; in the second case, a graphic should be permanently installed.

Recording a Power Load

THE CURRENT supplied to larger installation may be determined in a similar manner, except that a shunt must be used on direct current and a current transformer on alternating current. The solenoid type is not well adapted to the measurement of d. c. above 80 amp. although there are several cases where the solenoid is operated from a standard shunt. Up to 80 amp., the whole current is put directly through the winding, the size of wire or strap varying according to the full scale capacity desired. The solenoid graphic finds its greatest application in a. c. work, as a 5-amp. meter may be used with any capacity primary current transformer.

For general testing purposes, the transformer shown in Fig. 6 is unexcelled. By a simple manipulation of plugs, the ratio may be changed from 10, 20 or 40 amp. to 5 amp. on one capacity, and from 25, 50 or 100 to 5 on another. For work running from 100 to 400 amp., the the transformer in Fig. 7 may be used. There is no primary winding, but the transformer is energized by simply running the line cable through the hole. For instance, if the wire passes once through the hole, the ratio is 400 to 5; if it is passed through twice (like Fig. 10), the ratio is 200 to 5; if 4 times, then it is 100 to 5.

In case a circuit cannot be opened, the transformer in Fig. 8 may be used. By loosening a clamp the transformer opens in two parts, which may be slipped over the cable, reclamped and it is ready for use.

Transformers have the distinct advantage that they may be connected with the primary in a high-tension line (up to 2200 v. with these types) and the secondary meter

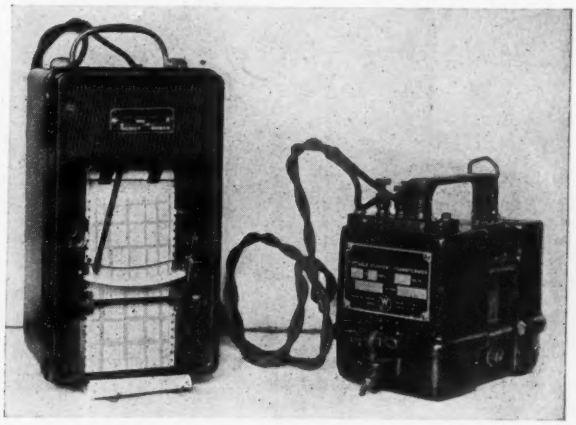


FIG. 8. SPLIT TYPE CURRENT TRANSFORMER

circuit is safe to work with. Great care must be exercised, however, that the secondary is never open-circuited while the primary is energized.

Figure 10 shows the method of connecting in on a three-phase power circuit. "Big-brute" clips are used on a heavy cable, which is run through the transformer and connected to both sides of a fuse. When everything is ready, the fuse is removed, thus starting the graphic without an instant's delay.

Interpreting Power Records

THE ACTUAL power used in a motor circuit is more difficult to determine than a lighting load, on account

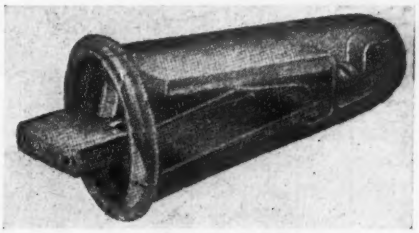


FIG. 9. "BIG BRUTE" TESTING CLIP

of the power factor. The table presented herewith gives a good idea of the current in each leg of a two- or three-phase induction motor circuit. For two phase, multiply the single phase current by two. For instance, assume the graphic in Fig. 10 to be connected to a 440-v. three-phase induction motor. The graphic, say, shows 3 amp. Since there are two turns in the transformer primary, its ratio is 40:1 (200:5) so the primary current is 3 times 40 or 120 amp. Referring to the table, under 440-v. motors, 3-phase column, the nearest figure

is 124 which shows that the motor is taking about 100 hp.

Of course, these figures are by no means accurate, when considered from a cost-charging basis, but their value lies in comparison of loads, at different times of the day, and for different classes of work. They are invaluable in rearranging motors and loads and in checking up the efficiency of workmen and machines.

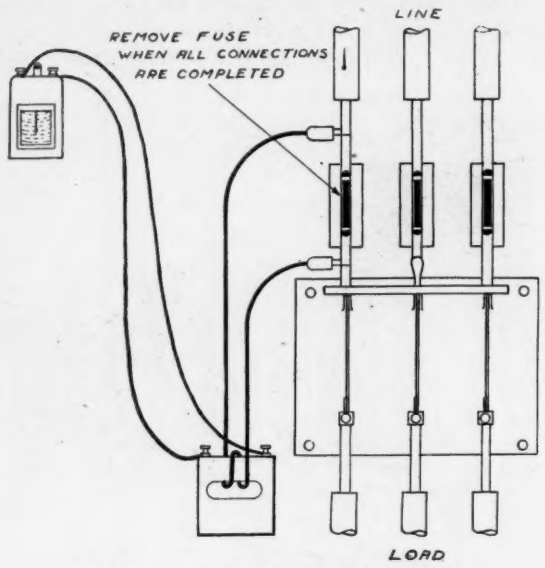


FIG. 10. INSERTING GRAPHIC IN CIRCUIT

Figure 1 gives a record of the operation of an automatic grinder. It shows the motor started at 6:30 a.m. but although the shop started work at 7 a.m., the workman did not start grinding until 7:30. From then until 10 a.m., he worked steady. The work was jammed against the wheel at 7:45 and 8:00. From 10:00 to 10:30 he didn't make a grind although the motor was running. Then steady work until 11:30. From 11:30 until 12:00 (when the motor was stopped), the "no load" was heavier than before. This singular condition was noted day after day and investigation of its cause disclosed the fact that the workmen connected two electrically-heated coffee pots on at this time.

APPROXIMATE AMPERES PER TERMINAL* FOR INDUCTION MOTORS

H.P. Of Motor	110 V.		220 V.		440 V.		550 V.	1100 V.	2200 V.
	2-Ph.	3-Ph.	2-Ph.	3-Ph.	2-Ph.	3-Ph.	3-Ph.	3-Ph.	3-Ph.
.5	3.3	3.7	1.7	1.8	.9	1.			
1.	6.	6.5	3.	3.2	1.5	1.6			
2.	10.5	12.	5.	6.	2.6	3.	2.5		
3.	15.	17.	7.5	9.	3.8	4.5	3.5		
5.	27.	30.	13.	15.	6.5	7.5	6.		
7 5			20.	22.	10.	11.	9.		
10.			25.	29.	12.5	14.	11.		
15.			35.	41.	18.	20.	16.		
20.			48.	55.	24.	27.	22.		
25.			54.	62.	27.	31.	25.		
30.			70.	81.	35.	40.	32.	16.	8.
40.			96.	109.	47.	54.	44.	21.	11.
50.			110.	127	55.	64.	52.	27.	18.
75.			165.	192.	83.	96.	77	39.	20.
100.			215.	248.	108.	124.	100.	50.	25.
150.			330.	366.	160.	183.	147.	80.	40.
200.			410.	475.	205.	237.	192.	98.	49.
250.			510.	590.	250.	290	237.	125.	62.
300.			600.	700.	300.	350.	285.	150.	74.

*For single-phase motors, multiply the current per terminal for a two-phase motor by two.

FILING THE RECORD

SOMETIMES the record is kept in a roll; but if it is necessary to refer to it several times, a good plan is to cut the strip into lengths of 2 ft. (24 hr.) each, and file flat, like ordinary business letters, marking each strip with the date. A ½-in. board about 25 in. long and 4 in. wide forms a good base, the strips being laid flat and secured with rubber bands. In this way, the records are always available for immediate inspection without unrolling 10 or 15 ft. to locate a certain day's record.

*Taken from Westinghouse 1919 Diary.

Novel and Handy Electrical Test Instrument

BY C. W. EISENMANN

IN the two accompanying illustrations are shown a novel so-called four-in-one electrical testing instrument and the means by which it may be applied for the location of grounds and short circuits.

As an a.c. current detector it is a vibrating-reed instrument. The reed is tuned to the frequency of the circuit tested by means of a button on the front of the device. The part of the reed visible through the glass at the head of the instrument has encircling it and resting partly on it and partly on the glass, a ring made of easily visible non-magnetic material. The ring is of such diameter that it has an inclined or tilting position in relation to the direction of the reed. Thus, when in vibrating the reed moves downward, the part of the ring resting on it moves forward in the direction of tilt a small distance. Then, when the reed moves upward, the part of the ring resting on the glass moves forward in the same direction. This gives the ring a seemingly continuous motion as the reed continues to vibrate because these alternate movements of opposite sides of the ring take place very rapidly. The ring moves in either direction, depending upon the direction of the tilt, and the ring will respond equally well when the instrument is held on its side as when testing vertical wires. Thus the instrument will function on wires whatever their position.

It is understood that the current is detected through the insulation of the wire, and the instrument is not connected to the circuit, nor does the insulation have to be removed from the wire. The instrument will detect as little as 1/100 amp. through rubber insulation, making it considerably more sensitive than the small commercial exploring-coils on standard lighting frequency currents.

Since the flow of current through a wire can be detected without cutting the wire or removing the insulation, it becomes an easy and simple matter to locate grounds, shorts and crosses by sending a testing-current down through the fault and then tracing this current to the point where it leaves the wire to ground, or to another wire, making a cross or short. This saves much cutting of wires and later reconnecting. If the repairman prefers or finds it necessary to use a galvanometer, or drop-of-potential, method to locate faults in electrical machinery or apparatus, he can make a very effective and efficient galvanometer out of the instrument by taking a short piece of copper wire with sharp ends, using these ends as he would galvanometer or millivolt-meter leads and holding the instrument near or against this wire. With this arrangement the drop in a No. 10 wire

with only 1 amp. flowing can be detected with the contacts less than 2 in. apart. This is equal to the performance of many millivolt-meters.

Using the instrument as a current detector, not only can grounds, crosses and shorts be located, but blown fuses can in many cases be detected, dead transformers in multiple or polyphase groups located, and also discharging or "leaking" pole-type arresters located.

The frequency tester is identical with the current detector, but there is added a scale calibrated from 50 to 70 cycles whereby the frequency of the current can be read directly from the position of the "tuning" button. This gives the instrument a range equal to a standard switchboard frequency meter and saves the attendant in a small power house, where the expense of a switchboard instrument is not warranted, the trouble of taking the speed of the engine or generator, counting the poles of the machine and going through the regular formula with pencil and paper.

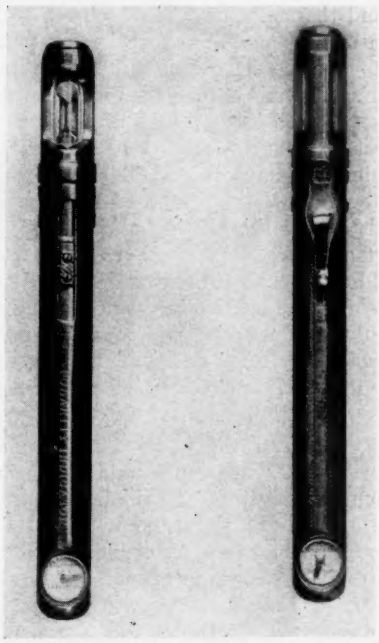


FIG. 1. FRONT AND REAR OF FOUR-IN-ONE ELECTRIC TESTER

The polarity indicator has a hand or needle which points directly in the direction of current flow by simply holding it near or against the wire. It does not have to be connected to the wire like other polarity indicators. This saves much time to the repairman. Aside from the well-known regular uses of a polarity indicator, this indicator used in connection with the alternator-current end of the instrument makes it very convenient to tell a.c. from d.c. wires and circuits, also live from dead wires.

This polarity indicator is simply a compass with an extra hand added that is at right angles to the regular needle in such a direction as to give directly the direction of current according to the relation of current to magnetic direction. To avoid confusion, the compass needle is entirely invisible, making an ideal polarity indicator giving direct readings and leaving no possibility of errors and confusion as is the case when using a common compass for this purpose. This indicator can be used in any position, and due to its novel one-way pointer, it is not possible to confuse any two ends.

The compass on the instrument is for testing magneto magnets, field poles on motors and generators, and solenoids and coils on apparatus. It can be used in any position, and, having an improved one-way needle, it is much easier to read and leaves no possibility of confusion.

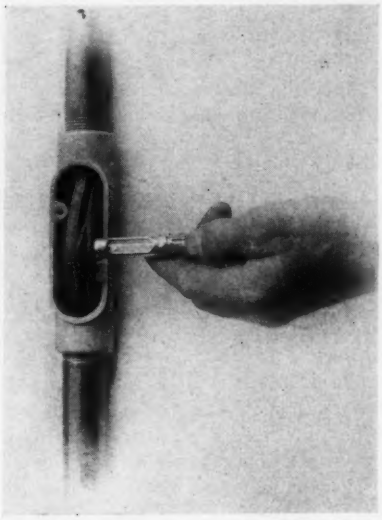


FIG. 2. SHOWING MEANS OF LOCATING GROUNDS, SHORTS OR CROSSES WITH FOUR-IN-ONE TESTER

Power Possibilities in Brazil

IN A review of industrial revival of Brazil, Engineering, London, points out that there are large power and manufacturing possibilities in that country, though, as yet, undeveloped. Iron ore of fine quality is plentiful, and in the southern part are considerable coal deposits, some of which have been partly developed. The coal is not of good quality, and is high in ash, but is available for power making and has shown satisfactory results in some recent tests in which it was used in pulverized form.

There is available some 50,000,000 hp. in waterpower, of which but a fraction of 1 per cent has been developed, due to lack of demand and distance from industrial centers. Fuel oil is found in considerable quantities and of good quality, and may become an important factor. The difficulty in the whole industrial development has been lack of transportation, as in a country nearly as large as the United States, there are only 18,500 miles of railroad, much of it single track, and all poorly equipped. The Brazilian government is now taking steps to encourage development of transportation and industry, and a large expansion of the power plant industry in that country is likely to follow.

THERE is no higher rank than that of worker. No title can ever make a loafer a noble-man.—Forbes Magazine.

Safety Methods Used in Welding

OUTLINE OF THERMIT AND ARC WELDING PROCESSES AND PRECAUTIONS TO BE TAKEN BY WORKMEN. PREPARED BY THE NATIONAL SAFETY COUNCIL

IT IS to be expected that unskilled workmen and makeshift outfits will be found in a trade that has grown up so quickly as the modern methods of welding and cutting by means of the gas flame and electric arc. It takes from six to eight weeks to train a man properly in the art of welding, and work of importance should not be tried until the worker has become efficient at using the apparatus. Operators are sometimes required to pass an examination on the fundamentals of the process before they are permitted to do any welding.

Safety in using any welding method depends on good equipment and careful handling rather than on any special advantage in the method itself. Modern methods are all good in their proper place and all safe if used with care. If they are not so used, any one of them may cause great loss of life and property.

Thermit welds are made by igniting a mixture of aluminum and iron oxide in a retort and running the iron that is reduced by the heat into a mold around the weld. This method of welding is useful when many welds all alike are to be made and in heavy work like welding track rails in paved streets or in repairing locomotive frames, crank shafts, or other large parts.

Combustion is started by first placing a small quantity of ignition power (barium peroxide) on top of the mixture and lighting it with a hot body or spark. Once started, combustion proceeds with great energy, raising the temperature to about 5400 deg. F. The iron is reduced from its oxide and the aluminum is changed to aluminum oxide. The iron flows into the mold around the weld, fusing the parts together and making the bond between them.

Few hazards are met in this operation. The mold should be thoroughly dried before the charge is lighted, and the crucible should always be provided with a cover. When the charge has been ignited, the operator should stand a few steps away and should wear goggles; those suitable for other forms of welding can be safely used for this method. Painful burns may occur by the metal splashing, or by upsetting the crucible, or by the breaking of the mold. Slight injuries frequently occur from taking hold of the apparatus or welded parts before they are cool.

The mixture of aluminum and iron oxide is neither explosive nor inflammable at ordinary temperatures, hence few precautions in handling it are necessary. It should, however, be stored in a dry place.

The ignition powder is furnished in airtight containers, which should be carefully stored, preferably in metal bins. These containers should always be kept securely covered to prevent ignition from sparks, as well as deterioration. Under no circumstances should the powder be applied to crucible until charge is ready for lighting.

Both arc and pressure welding have their own peculiar advantages and advocates. Many kinds of work can be done by either process and there is a difference of opinion as to which is the better. The whole art is in such rapid development that longer experience is necessary before it will be known for what kind of work each method is better adapted. Arc welding is slower and requires more labor but it can be done with lighter and cheaper equipment and in locations where spot welding is impossible. Pressure or spot welding requires relatively heavy and expensive equipment, but the process is easy, rapid, and cheap. The current varies from a few amperes for thin material up to 1000 amp. for very heavy work. The voltage varies from 10 to 115 v.

The positive side of the direct current electric circuit is connected to the work and the negative side to an electrode which is used as a tool by the workman. When the current is turned on, the electrode is touched to the work and then drawn away an inch or so. An electric arc of varying length and intensity is thus made between the work and the electrode. The high resistance of the air gap causes the metal at the weld and the end of the electrode to become heated to a temperature around 6000 deg. F. The metal fuses and can then be welded or cut.

The most necessary accessory is the electrode holder. This is a simple clamp made of light material and designed so it will be easy to hold and not overheat. In case there is overheating of the holder, it may be cooled in a bucket of water.

Arc welding machines are being developed with which the electrode is automatically carried along the weld, or cut, with a steady motion and constant speed. These machines when perfected will undoubtedly reduce the hazards of the work and increase its efficiency.

In pressure welding the edges of metal plates are brought together and the positive and negative sides of an electric circuit are connected, one to each plate. When the current is turned on the temperature rises to about 6000 deg. F. and the metal is fused. Pressure is then applied and the edges are welded. When used for welding wire it is called percussion welding. In spot welding, the parts to be welded are brought in proper position between two electrodes and a pressure applied as the current is applied. The energy required is about the same as in arc welding but the current is sometimes stepped up as high as 50,000 amp. or more with only 4 or 5 v. difference of potential.

Welding equipment is much like other electrical machinery for the installation and operation of which the provisions of the National Electrical Safety Code and National Electrical Fire Code should be followed. In large installations a competent electrical engineer should be in charge. Practically the only dangers which need be guarded against are such as are due to shocks, burns, and injury to the eyes. The voltage in most cases is so low that there is little danger of shock from the welding circuit but the usual precautions should be taken against coming in contact with high-line voltages.

All the light rays in the spectrum are given off by the welding arc. The infra-red rays which are invisible to the eye produce a sensation of heat. Orange yellow and green are the illuminating rays, which make objects visible. Blue rays obscure the vision and make objects

indistinct. The ultra-violet rays are invisible, and while they cause no immediate discomfort, they are very dangerous. They affect the skin like sunburn and may cause cataracts and even total blindness if looked at with the naked eye.

In welding, because of the great intensity of the arc (6000 deg. F.), it is of the utmost importance to provide lenses which will protect the operator from the injurious effect of the radiations. A glass which will reduce the brightness of the arc is not necessarily suitable for protection against the injurious infra-red or ultra-violet rays. Blue lenses are not satisfactory, as they do not protect against the harmful rays. Amber, yellow and greenish yellow are the most efficient for eye protection, being the most opaque to the injurious light rays.

Several reliable dealers are now able to supply glass which will provide sure protection against injury from the welding arc. The glass should be scientifically correct—that is, should show by a spectrum analysis that it does not permit the passage of an appreciable amount of the harmful rays. The Bureau of Standards has recently issued a paper (No. 93, "Glasses for Protecting the Eyes from Injurious Radiations") giving information concerning the protective properties of various glasses now available.

The face of the operator must also be protected from the heat rays; therefore, a shield (held in the hand or supported from the shoulders) or a helmet (worn on head or supported from shoulders) is necessary. The helmet offers the greater degree of protection since it protects the operator from reflected rays while the shields do not. The protective glass is usually inserted in this shield, or helmet, as the case may be. In some cases, however, the welder wears goggles fitted with light shade protective lenses, and the shield or helmet is fitted with a light shade protective glass, the density of the two glasses giving the required color.

On account of the intense heat of the welding arc, operators sometimes wear an asbestos apron or bib. Gloves are also often worn to protect the hands. Woolen clothing is preferable to cotton because it is not so easily ignited. It is recommended, however, that arc welders wear only fire-proofed outer clothing.

The reflected rays sometimes cause skinburn of operator's face or back of neck. It has been found that if the inside of welding room, draw curtains, etc., are painted black this will be largely avoided.

Sketching

FUNDAMENTAL PRINCIPLES OF GOOD SKETCHING BRIEFLY PRESENTED. BY S. C. SWANSON

BEFORE a workman can turn out a piece of work, the size, shape and material of which it is to be made, being unknown to him, he must first be given the necessary instructions. Besides being somewhat lengthy, verbal or written instructions are likely to be misleading, and drawings are, therefore, used instead, as being clearer, and more quickly and easily read. Such drawings are frequently made in a more or less unfinished style commonly called "sketches." The fact that the term "unfinished" is used does not indicate a lack of data, but rather that the sketch is produced in a more or less rough style, frequently entirely freehand.

Sketches may be divided into two general classes, according to use, those which are used as working drawings, and submitted direct to the workman, and those which are used merely as preliminary data sheets, for the subsequent preparation of finished drawings. Sketches submitted to a workman must be so complete as to leave no doubt in his mind as to the desired shape and all the important dimensions at least. The lines should give him, with a reasonable degree of accuracy, the shape desired in the object to be made, and the dimensions should be clearly given.

While working sketches for the shop must be fairly accurate, those used in the preparation of finished drawings must be even more so, for while the shopman may be able to make small adjustments as the work progresses, the draftsman often does not see anything more than the sketches given him. His sketches must, therefore, be complete enough to give him all the data he requires, the main point to be observed in making such sketches being accurate dimensions.

Another use of sketches is in connection with articles submitted to magazines. The incomplete and rough (literally) sketches which are sometimes submitted are almost sufficient to make the draftsman's hair turn gray before its time. This class is, however, a small minority, the majority being "fair to middlin'."

Unless one is familiar with the requirements for drawings used in making cuts for illustrations, it is a waste of time to make finished drawings. Most magazines have a certain standard which all illustrators must follow, and it is, therefore, frequently necessary to redraw or at least to trace an otherwise good drawing in order to secure the desired results.

Aside from standards, there are also the weights of lines, sizes of lettering, etc., which must be taken into consideration. Ordinarily drawings are made from one and one-half to three times the size which they finally appear in the printed pages. Sometimes, however, the originals are as much as ten times the size of the finished cut. This is true in the case of cuts showing plans and elevations of buildings, which are traced from large drawings. Many useless lines must be eliminated from such drawings to make good magazine illustrations. It is best, therefore, to submit good, clear sketches or drawings which can be redrawn, traced or inked in by the draftsman to suit the standards of the publication in which they are to be used.

From the foregoing remarks it is evident that the ability to make a good, clear sketch is valuable. The power plant man can cultivate this ability to good advantage in more ways than one.

There are two general classes of drawings. One is orthographic projection, Fig. 1, in which at least two views are usually required, and frequently three or more. The other method is perspective. A perspective

XUM

drawing may be true perspective, Fig. 2, in which receding parallel lines, if extended, disappear in a "vanishing point," as in a photograph, for example; or isometric, Fig. 3, in which all lines, that are in fact parallel, are so made on the drawing or sketch.

The type of drawing in most common use is the orthographic projection drawing.

Orthographic Projection

A sketch in orthographic projection presents an object in various views as it would appear, were the eye at an infinite distance. This is accomplished by projecting various lines and points perpendicularly to a horizontal, vertical, or inclined plane. This principle is illustrated in Fig. 4, which shows the projection of three

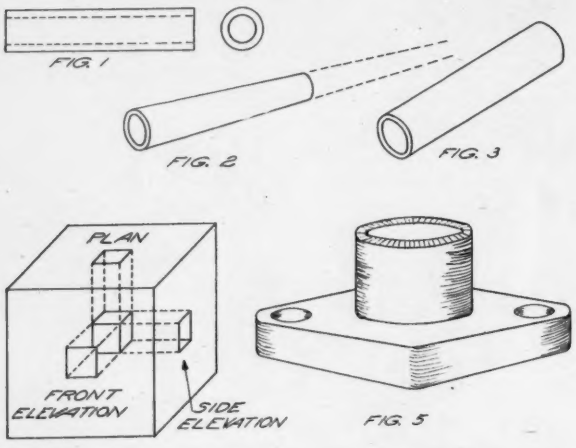


FIG. 1. ORTHOGRAPHIC DRAWING OF PIECE OF PIPE
FIG. 2. PERSPECTIVE DRAWING OF PIECE OF PIPE
FIG. 3. ISOMETRIC DRAWING OF PIECE OF PIPE
FIG. 4. ILLUSTRATING THE PRINCIPLE OF ORTHOGRAPHIC PROJECTION
FIG. 5. PERSPECTIVE OF STUFFING-BOX GLAND

views of a cube. Figure 4 itself is drawn perspective to bring out this point clearly.

In order for a sketch to be of greatest value, the shape of the object drawn must be fairly accurately shown. The first thing the eye sees in a sketch or drawing is not the size, but the shape. The lines are seen before the dimensions and care should, therefore, be taken in placing them so as to give the desired impression.

The next mental question is as to size; how large is it? This should be answered by main overall or center to center dimensions. At this point the observer has all the general information required, unless the object is to be made, or the sketch transformed into a more or less finished drawing. In the latter case, he will look for more information; diameter of holes; radii of curved parts; lengths and widths; degree of finish required; material to be used; and such other detail as may be required.

Making a Sketch

Figure 5 shows a stuffing-box cover. Before proceeding to make a sketch of this object, the number of views, which will be necessary to give all the required information, must be determined. In this case two views will suffice; one a top view (considering the position in Fig. 5 as proper) and the other a front elevation.

The first lines drawn are the center lines, from which the other parts are properly located, Fig. 6. The piston-rod hole is placed at the intersection of the center lines and the other parts are located by pointing off approximately the correct distance along one or the other, or from both center lines. The lines in a rough sketch of this kind are usually all drawn free hand. The main difficulty encountered in this work is in getting the object proportioned properly, so that it will "look right." This is where the eye comes in, and the imagination to be able to see the object as it should look on paper. The eye is to be imagined at an infinite distance from the object. All surfaces at right angles to the surface facing the observer will then appear as straight or curved lines or parts of circles.

The front elevation is drawn in the same manner as the plan view, but considering the eye at an infinite distance away in front. This view is drawn below the plan view, with its base line parallel to the center line of the plan view. The result is shown in the lower view of Fig. 6, ignoring for the moment the dotted lines.

Indicating Hidden Surfaces

Without the dotted lines, however, we would not be able to understand from this sketch the shape of the

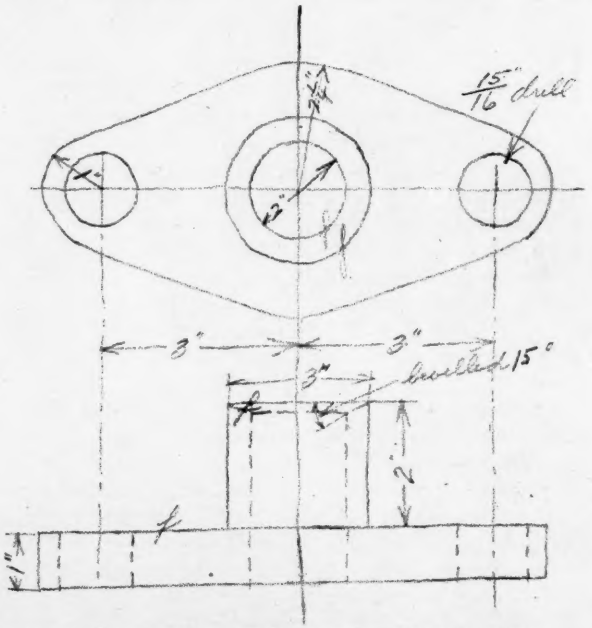


FIG. 6. PENCIL SKETCH OF STUFFING-BOX GLAND

object portrayed, unless we were told the purpose for which it was to be used. The top view gives no indication as to whether the hole for the piston rod or the bolt holes go partly or all the way through. It is, therefore, frequently necessary, as in this case, to indicate some of the "hidden surfaces" by means of dotted lines. The number of such lines should be limited to as few as possible, as they are confusing if too numerous, especially in a rough sketch. It is sometimes advisable to make one or two extra views or cross-sections rather than to use too many dotted lines.

These two views now give a good idea of the shape, but without dimensions, indicate nothing as to size. The most important dimensions are the inside and outside diameters of the part which enters the stuffing box and the distance between centers of the bolt holes. These dimensions are determined and marked on as shown. The addition of the remaining dimensions and notes, as shown in Fig. 6, completes the sketch.

Curved lines which are parts of true circles are dimensioned by giving the radii of the circles. Wherever a finished surface is desired the lower case letter "f" is written, intersecting the line representing the finished surface. Rough sketches are not usually lettered, all notations being merely written in.

Comparison of Fig. 6 with Fig. 7 shows the difference between a well proportioned and a badly proportioned sketch. Although Fig. 7 gives all the data necessary to make the piece shown, it does not give a clear mental picture without considerable effort. The use of cross-ruled paper, 8 or 10 squares to the inch, is a great help in making properly proportioned sketches, as they may then be drawn to scale, each square representing a certain distance.

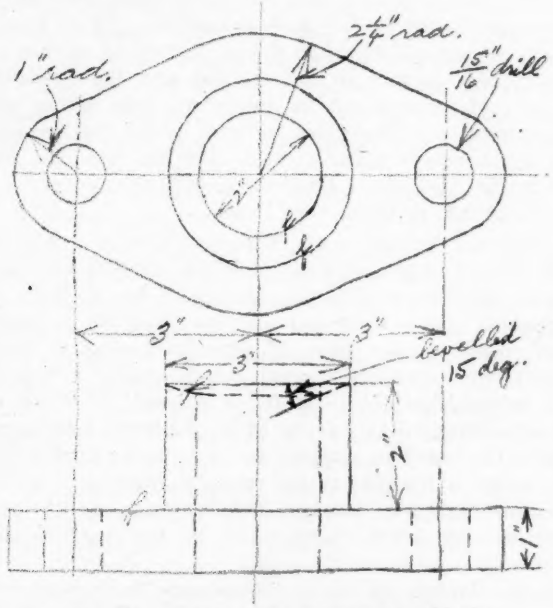


FIG. 7. A BADLY PROPORTIONED SKETCH

When all the necessary information cannot be shown in a plan and front elevation, as in the gland shown in Fig. 6, it is necessary to give an end elevation of the object. This is drawn in exactly the same manner as the front elevation but usually with its base at right angles thereto and directly opposite one end of the plan view. Both ends are shown when they are unlike each other.

There is still another method of revealing the slope of an object which cannot be shown in the plan or elevations. This is by means of a cross-sectional view, which represents the object cut on a plane usually at right angles to the outer surfaces. Figure 8 shows a link, which might be used for a variety of purposes. The front face is shown in a plan view and the edge in elevation. An end view is not necessary in this case, but a cross-section is, in order to show the I-beam slope. The link is shown broken away and the cross-section inserted in the breech. It will be noted, further, that in order to reduce the length of the drawing, and to allow the ends to be drawn large enough to be clearly shown, the length of the link is not to scale, but is drawn as if a portion had been broken away from the center.

The cross-sectional view is not always drawn as here shown, but frequently constitutes an independent view itself.

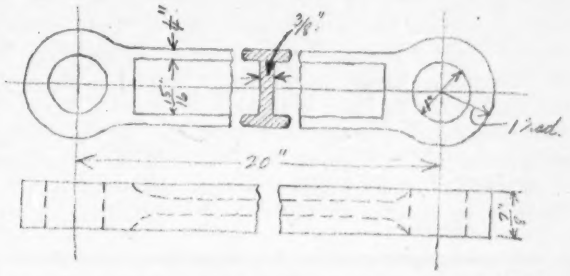


FIG. 8. SKETCH SHOWING THE USE OF CROSS-SECTION

In these remarks, it has not been attempted to cover the whole field of sketch-drawing, but merely to cover some of the fundamental principles. Much depends on the observation and imagination of the man making the sketches, but ultimate success is attained by practice, and possibly in an even greater degree by a study of past failures, as in everything else.

Well, Isn't That Flexible Tubing?

TIM AND CONNIE were new employes at the electrical supply house. Their duties consisted of trucking, but being hard workers, they were generally liked.

The shipping clerk, approaching Tim, said: "Please go over to the stock room and get me a coil of flexible tubing."

Tim did not like the idea of saying that he would not know the article when he saw it, so he hunted up Connie and said: "Say, phat's phlexible tooben?"

"Well, ye know phat tooban is?"

" 'Tis a thing loike a poipe."

"Arrah, but the phlexible?"

"I hov it, I hov it," so picking up the dictionary they read: "Flexible: Capable of being bent, or twisted without breaking."

Hurrying to the stock room, the first thing they espied was a garden hose. It fulfilled the specification and was delivered to the shipping clerk.

J. B. DILLON.

FIRST YEAR of co-operative course in electrical engineering conducted by Massachusetts Institute of Technology and Lynn, Mass., plant of General Electric Co., is reported to have met highest expectations and enrollment for next year is much enlarged; course covers 5 yr., first two being identical with the regular course in the same branch at the Institute and last 3 yr. being divided between instruction in theory at the Institute and in practice at the company's works; theory and humanistic studies, however, are carried on while students are at the plant, and practical work is carried on at the Institute, the difference being in emphasis and manner of supervision; students are paid hourly rates while at the works.—Industrial News Survey.

XUM

Actualities in Industrial Russia of Today

CHAOS UNDER BOLSHEVIK CONTROL, PRESENTING FACTS, NOT THEORIES —WORKLESS WORKERS, DISEASE, VERMIN, STARVATION AND DEATH

TO OUTWARD appearance, the Russian *bourgeoisie* have become reconciled to the Red regime in their country, for almost without exception they have accepted employment with the Bolsheviki. Everyone must be employed by law, particularly males from 16 to 50 yr. of age; but to work according to the usual conception of the term, simply is not done. Everywhere, in all enterprises, there are so many employes engaged, that such work as there is to be done could be finished with dispatch; nevertheless they prefer to sit around and smoke, flirt and discuss their love affairs, the subject of eating, and where and how one can negotiate the purchase of, or arrange an exchange for something to eat.

Author Relates Personal Experiences

This article was procured from a foreigner who spent the greater part of his life in Russia, much of his education having been obtained in that country. For several years he was associated in Russia with a well-known manufacturer and distributor of compressed air machinery. He elected to remain in the country in the hope that an improvement in economic conditions would set in within a reasonable length of time after the Revolutionists had been afforded an opportunity to put their political and economic theories to the test of practice. Like everyone else, he was forced to find other occupation in order to live, because it was now too late to leave the country, and therefore, he sought new employment as outlined in his article.

Recently (late Spring, 1920), a fortunate turn of events opened the way for him to leave Russia and he was not long in taking advantage of the opportunity. This communication was in the Swedish language, and has been translated in New York. For obvious reasons the author's name is not given, and also, where individuals are referred to, fictitious names are used.

The educated middle-class school teachers, clerks and office assistants are having a very difficult existence, because the brainworker is very much underpaid. Salaries run from Rs. 5000 to Rs. 8000 per month. Such people, therefore, endeavor to procure employment where, in addition to salary, they receive a daily allowance of from one-fourth to one-half pound of bread—and a Russian pound is only 14 oz. avoirdupois. Such an enviable position can only be procured when influence is brought to bear by some one reputed to be a communist by conviction, and thoroughly loyal to the *Soviet* government.

Without the advantage of this special influence, one is forced to resort to the labor exchange, where every worker must be registered. But unhappily the chief function of these labor exchanges consists in disbursing the daily allowance paid to the so-called work-seekers, who also there consume the daily mid-day soup provided for them gratis.

Whenever an enterprise is in need of a really competent worker, the labor exchange is circumvented through the employer and his prospective employe coming to an outside understanding and mutually arranging to report simultaneously to the labor exchange; the former as desiring to employ a certain class of worker, and the latter as having located an available position with the former.

It is a matter of extreme difficulty for a foreigner, English and French in particular, to land a good job. To begin with, references from three Communists are required, and as foreigners do not associate with such, this condition is not easy of fulfillment. Moreover, foreigners are always open to espionage and are continually being victimized by informers. I secured my references through Boris's family, and supported by Dimitrieff's influence was successful in obtaining an appointment in a chemical factory.

This factory, which the Bolsheviki are trying to open, is to be absorbed into the ramifications of the former State Spirits Monopoly. Production has not yet commenced, because it was intended to change the location of the steam boilers; but they contemplated producing principally Epsom salt and saccharine. As, however, many elements essential to the production of saccharine are totally lacking in Russia, and also the available supply of common salt for converting into Epsom salt is extremely limited, this industry is for the present at a complete standstill, except for the fact that the entire force of laborers and office staff were maintained at full strength doing very little.

My job was classified as one of so-called responsibility, and rated according to the first category with pay at Rs. 6000 per month with extra allowance of ⅜ lb. of bread daily, 10 lb. of salt monthly (possibly to avoid the embarrassment later of actually having to start the production of Epsom salt) and one-half a fathom of firewood monthly. A full "fathom" of wood in Russia is a pile 7 by 7 ft. by 14 in., the latter dimensions being the length of a stick. As I also took over the distribution of firewood to the employes, they were going to raise my pay another Rs. 2000 per month and increase my bread ration to ½ lb. per day, instead of ⅜ lb.

This factory had about 100 laborers on their payroll who worked only every once in a while at tearing down wooden structures and houses in the vicinity for the lumber, conveying it to the factory premises, where it was redistributed amongst the employes as firewood.

The laborer's working day was fixed at 8 hr., and that of the office employes at 6 hr. Of the few factories still maintained in operation, production has ceased in about 90 per cent of them on account of lack of fuel, machinery, tools and, last and not least, raw materials of production. The workers in these plants are mainly occupied in electing *otryady*, or "flying columns" from among their number, to be sent to the so-called "Bread *Gouvernements*" (Saratov, Samara, Witebsk, etc.) with orders to purchase for the other workers in their plant, supplies of flour and cereals. If one is so fortunate as to boast the acquaintance of any one of these *tovarishtshi* (comrades), it is possible to acquire a few pounds of the delicacies he has brought along; of course the accommo-

dating one will calculate several hundred per cent profit for himself in return for his generosity, but even so it comes cheaper this way than buying such produce from dealers.

Wherever you go, very little work is being done; for instance, at Poutiloff Works they repaired only 11 locomotives in half a year, and in the last two months of this period, January and February, 1920, but two engines were made ready and these for their own use, because they were faced with the necessity of hauling provisions from Siberia for the Poutiloff Works' employes and workmen. The Oboukhoff Works are engaged only in repairing railway cars, no new cars are being built because the necessary raw material and coal for fuel are lacking.

The steam boilers in all factories are being fired with building lumber or with green firewood brought straight from the forests as soon as cut. In order to obtain firewood, all wooden houses, fences and other structures in the vicinity of the factories are torn down and forests lying within an area of 20 *versts* (12 miles) radius from Petrograd are being felled, converted to firewood and transported to the factories and immediately consumed.

Now that the Bolsheviki have rounded up and consumed all known accumulations of foreign supplies and stocks of raw materials, I do not hazard a guess as to how they shall be able to carry on in the immediate future. Everything seems to be lacking, nothing, absolutely nothing remains. I never could have believed that a country could be stripped so completely bare as has been accomplished in Russia within the relatively short time of two years.

It is quite impossible for any mortal to obtain sufficient to eat on salaries of 5000 to 8000 roubles per month, because beyond the daily ration of ⅜ lb. of bread and a boiled soup, prepared from frozen or decayed cabbage, quite innocent of any grease or fat content, and thoroughly unappetizing, nothing is supplied on ration cards. Laborers and Soviet employes discharging responsible duties are allowed in addition to the foregoing ration from ⅛ to ½ lb. of bread extra and for dinner are provided with a cereal dish and if in addition to that one is furnished with salt and firewood one then becomes an object of universal envy. For instance, in Pavlovsk I was able to exchange 6 lb. of salt for 40 lb. of potatoes, but there are very few individuals placed so advantageously.

On Sundays and also at times on week-days, the ladies of the *bourgeoisie* are to be seen sitting in the market places and offering for sale their worldly possessions, such as precious stones, watches, china and porcelain, furs, clothing, and other valuables, all of which are purchased exclusively by soldiers, sailors, peasants and *kommissars*, who pay exorbitant prices. The sellers then go around and spend the proceeds with the so-called "marauders" (or brokers and dealers in produce). They obtain rye flour at 450 roubles; white flour at 800 roubles; butter at 8000 roubles; bacon at from 2500 to 3000 roubles; bread at 350 roubles; potatoes at 180 to 200 roubles; all prices are per Russian pound of 14 oz. avoirdupois weight. A salt herring now costs 500 roubles; one egg 200 roubles; 25 cigarettes from 250 to 300 roubles; ⅛ lb. of *Mahorka* 300 roubles.

In order to live with any semblance of comfort in Petrograd at present, an individual requires a minimum income of from 30,000 to 40,000 roubles a month, but even so his appetite will never experience a sensation of complete satisfaction nor will he be able to keep up his physical strength.

One always goes around with a tired, exhausted feeling, because what all is one not called upon to do after being relieved at four o'clock from the Soviet job? Firewood has to be cut, and in my case, carried up to the sixth floor; then there is the water to be carried upstairs because on account of the poor pressure in the city water pipes, the water only reaches the third floor. In our family we had the good fortune to live in a house where the water pipes had not yet been burst by the frost, but in all neighboring houses it was necessary to carry up the water all the way from the street. When there is snow and ice to be removed from the streets, the tenants of the apartment houses are forced to do this because janitors and door keepers have been abolished by decree and are not permitted to exist in any house; but where such are found in spite of the decree, then the house committee is heavily fined and the janitor is impressed into public labor.

No buildings are being repaired or maintained in condition, there being neither labor nor materials available for this purpose. It is, therefore, not surprising that buildings have depreciated to a very unsanitary condition and I have actually been in houses where the drainage pipes have been burst by frost and the contents poured down the stairs in a cascade; but nevertheless these dens of pestilence continue to be occupied by human beings. When the thaws commence things are certain to become much worse.

No individual is permitted to change his place of residence without the consent of the lodging committee, which is incorporated in the Council administrating every city precinct. One room is allotted for an individual and so my parents with a family of three, who occupied a five-room apartment, were forced to take in two sailors as lodgers. As things are, no one attempts to move, there being in addition to the foregoing troubles, a great scarcity of lodgings, due to the fact that almost all wooden houses have already been torn down and used as firewood; and also the luxury of moving costs a small fortune of from 20,000 to 30,000 roubles.

As far as wearing apparel and foot wear are concerned, it is almost impossible for the average individual to swing sufficient capital in order to make new purchases. A pair of lace shoes manufactured by "Skorokhod," workmanship miserable, can be obtained at the market place through sailors at from 12,000 to 15,000 roubles a pair. Overshoes containing more tar than rubber, cost from 9000 to 10,000 roubles a pair. Sailors seem to be amply supplied with such articles as they are looked upon as the "guardian saviours" of the Revolution, or as Trotsky says, "The Flower of the Revolution." Therefore, they enjoy special privileges and are well taken care of.

Of all the industries in Russia, the state plant of printing and engraving reaches the greatest degree of efficiency, and is working to full capacity. Here the money or *leninki* is produced. Operation goes on day

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and night and printing proceeds without interruption. The workers in this plant are shown every consideration.

No money is now prepared in denominations of less than one rouble and the following notes or "tokens" are turned out:

Rs. 1, 2, 3, 5, 10, 15, 25, 30, 50, 60, 100, 250, 500, 1000, 5000 and 10,000.

Copecks no longer are in circulation, or at least in rare instances, because the cheapest article is a newspaper which costs two roubles or a ride in the street car which costs three roubles. The peasants in the country refuse to accept "money" in payment for their wares. They already have acquired whole chests full of paper money and finding it to be utterly worthless, they now are only willing to enter into exchange transactions so that they can receive in return for their produce such articles as old clothing, articles of gold or silver, linen, shoes, over-shoes or boots, salt, etc.

A truck driver charged us twelve thousand roubles to haul our luggage from the Vassili Ostroff to the Finnish Railway Station. (This is about two miles and a half.) Horses are universally in a half-starved condition, so drivers limit a load to 35 *poods* (a *pood* being 36.1 lb. avoirdupois) and even then it is not unusual to see a horse suddenly give up the ghost, quietly lying down on the street never to rise again. The meat of such an animal can be sold for from 300 to 400 roubles a pound (of 14 oz. avoirdupois weight) and is in great demand.

Nevsky Prospekt, once Petrograd's pride, is now nothing but a country road. All shops have been closed and the windows sealed up with boards; the wooden paving blocks have long since been torn up (for fuel) and have not been replaced with anything else. The sidewalks are crowded with degenerate loafers supposed to be soldiers, or *Soviet* employes. The finest buildings have been given over to and are occupied by various governmental institutions.

Along the entire length of the Nevsky Prospekt (Petrograd's Fifth Avenue, and about four miles long), there are not more than 10 tiny little shops still open, in the main owned by Jews, and where such small necessities can be procured as saccharine benzine (75 roubles for a very small bottle), hair pins (150 roubles for 10) flowers, Eau d'Cologne (3000 roubles a small bottle), etc. All of the remaining space and former business premises serve as warehouses for office and private furniture which have been requisitioned; and any proper Proletariat is permitted to go to these places and fetch any furniture he considers he needs.

It is typical of the times to note that every "elegant" Russian must have a writing desk, whether he knows how to write or not, and preference is shown for the so-called American roll-top variety, wherefore, this type of furniture is in exceptional demand.

Street cars were still running when I left but most of them were broken down, and of the former 800 motor trams only about 100 are able to maintain operation; the balance have been dissected to provide necessary spare parts for those few remaining in anything approaching running condition. The car barns are now full of abandoned car bodies which are lying around by the hundreds. How long the last surviving cars will be able to maintain operation, I do not know, but the way things are now, there are usually about 150 passengers riding in, on and around a car originally constructed to accommodate a maximum of 50. When continually subjected to this degree of overloading any tram car can be expected to hasten towards its ultimate end.

Only 50 of the available cars are allotted to passenger traffic; the balance are used as city postal cars and as municipal freight carriers. The street cars operate only from 9 a. m. to 6 p. m., and on Sundays and holidays there is no service at all.

The railways are almost at a standstill. At the present time, there are only two passenger trains a week between Petrograd and Moscow and they take from five to seven days for the trip. This formerly was a 10-hr. run, being about 400 mi. To travel on these trains, a special permit is required in order to obtain a ticket and there is only one class of accommodation where there were formerly three classes. If fortunate, it might so happen that you land in a first-class compartment, but if you are out of luck, you may end up in a freight car with a little iron stove, for which there is usually no fuel, set up in the center. Boards are then built around the sides to serve as bunks. The printed inscription on the outside of the car surviving from bygone days of military preparedness, announces that this car will hold 40 men or six horses. This quota is usually far exceeded as far as human passengers are concerned.

It was officially announced that passenger traffic had been cut down to this extent in order to facilitate freight movement, but the fact remains that shortage of rolling stock was the real underlying cause; and the available equipment is in such a miserable state of repair that the time is not far off when the railways will no longer be able to even keep up a semblance and transport will cease entirely.

Post and telegraph continue to operate within the confines of the internal Empire, but foreign countries are shut off altogether. This internal traffic is very slow, and an urgent telegram handed in at Moscow may be delivered in Petrograd through the local post office three or four days after it is handed in. No postage is required for ordinary letters and the quality of service rendered is in keeping. Registered letters cost three roubles and these usually are delivered.

Hotels and restaurants no longer are in existence, and the would-be traveler must seek refuge with friends or relations, but if he is blessed with the distinction of being an official guest of the Government, he is put up in either "Smolny," a former very exclusive school for young ladies of the aristocracy or in the Hotel Astoria (*Soviet* Headquarters), where nothing is lacking.

The former restaurants "Medved" (The Bear) and "Pivato's," have been converted into public kitchens, and are ghastly with filth. The Hotel Europe is an orphan asylum and kindergarten.

Automobiles are almost conspicuous by their absence, and such as are still in service are only at the disposal of very high *Kommissars* and even then are in semi-defective condition.

All theaters are working full blast, and doing a

tremendous business. Seats cost from 125 roubles up, and at the Mariensky all seats are permanently taken up by Communists of high rank, so that mere mortals are never so fortunate as to obtain admission, unless, just as in the former days of the Imperial Government, it is possible to procure the influence of someone of powerful position—with the exception that your protector will now possibly be a letter-carrier, whereas formerly he had to be at least a general. The audiences are mostly made up of sailors, soldiers and their feminine appendages. The women are loaded down with jewelry, and the new Mariensky Theater frequenters attempt to ape the brilliant audiences that formerly thronged the building.

Apropos of vermin, it is said in Russia that "the newest and most malignant internal enemies are the vermin," and no truer word was ever spoken than by the man who first coined that sentence. Tram cars, railway cars, theaters, prisons and hospitals swarm with them and people are dying by hundreds of thousands on their account. In February of 1920, 65,000 died of spotted typhus in Petrograd. A hospital nurse personally known to me, told me in despair that the hospital where she worked was so over-run with vermin that it almost seemed as if she could feel them under her feet when she walked across the floor. There are even cases of record where people suffering from inflammation of the lungs have been taken to hospitals, there to become infected with the dreaded spotted typhus! For the time being the *Soviet* Government is confining its efforts to fighting this new peril with decrees through which they proclaim that the only way to exterminate the enemy is through meticulous cleanliness! But how is one to conjure up this degree of cleanliness, when such a thing as soap does not exist?

At the time we left Petrograd, not only "spotted typhus" was epidemic, but hunger typhus, small pox and cholera as well. Patients suffering from these diseases were transferred to isolation barracks mostly to die; a mortality rate of 80 per cent in such cases has been estimated, because there are no longer any kinds of medicines or disinfectants available. All surgical operations are carried out without the aid of anaesthetics, neither chloroform nor ether being obtainable.

Corpses of those who have died in barracks are transported to the burial grounds in large motor trucks, which carry from 30 to 40 coffins at a load. They are then interred in great common graves. People who died in their own homes are transported by their relations to the burying ground, either on small hand cars, or in winter on children's sleds, because hearses ceased to exist long ago. The undertaking business was first nationalized by the *Soviet* Government and then abolished because the regional *Soviet* claimed they could spare no horses for such luxuries as funerals. The poorer classes, such as former millionaires, bank directors and generals, are even brought to the burial ground in rented coffins and these coffins must then be immediately delivered back to the rentor, upon arrival at the grave.

The passport system has been re-established and is even stricter than it ever was during the days of the Imperial Government. All people claiming Russian citizenship, or being unable to deny it, are compelled to report to their district *Soviet* and a new *"Sovietsky"* passport is then issued to them. All others, that is foreigners, must report semi-annually to the foreign section of *Kommissariat* of the Interior and each time they are re-registered. In addition to the ordinary passport, males from the age of 18 to 50 yr. are required to carry a special employment certificate (Udostoverenie Mesta Sluzhba) in which the record of the place of their employment is kept. If unable to produce this particular "pass" they are considered as being "out-of-work" and are then forced to accept employment at public work. Doing "public work" consists of cleaning out barracks, municipal stables, public baths, etc., digging so-called common graves and burying corpses.

Such *bourgeois* as have not accepted the doctrines of the Reds, like former large merchants, bank directors, generals, priests, etc., and like our former lawyer friend, Mr. Popoff, are carried on a special register and are considered as hostages; these unfortunate beings can expect summary arrest without cause at any time, and until recently this was followed by execution before a firing squad.

Happily the death penalty has at last been abolished after thousands of unfortunates were the victims of this policy. Now innocent people of this type are only required to sit in prison and become infected with every variety of contagious disease and thus expire, but they may no longer be shot.

Traveling back and forth to and from foreign countries is no longer permitted because all frontiers have been closed and declared in a state of war.

Petrograd has been policed for some time by girls of from 17 to 25 yr. of age. Male militiamen are rarely seen because all ablebodied men have been drafted into the Red Army. It is a sight not altogether void of humor to behold half a dozen doughty *Militsionerkas* with army carbines slung over their backs, driving before them a bunch of from 30 to 50 husky men headed for the sinister Gorokhovaya, No. 2.

These rascals are to be seen selling their illicit wares in the open market places. The Bolsheviki fear to take any steps for stamping out this practice because of the ever constant danger of precipitating an uprising.

All schools are free in the sense of being gratis ,but the Russian peasant as he is, is so suspicious that he declines to send his children to school. To combat this, a decree has been promulgated rendering it obligatory for all citizens between the age of 15 to 60 yr. to know how to read and write, but this order, the same as others like it, is universally ignored and the masses remain just as uneducated as ever, only they are by far more rough and cruel. The way things are arranged, it is even possible for anyone who is literate to receive an engineer's diploma after going through a course of study lasting four months.

All of the foregoing is an accurate and truthful account of present day conditions in the Empire that was formerly so fabulously rich. Of the former glamour and beauty, nothing, literally nothing, has been able to survive, and it is impossible to avoid feeling a deep sense of pity for this people who from top to bottom are naturally so well endowed with intelligence, but who have now been sacrificed upon the altar of experiment by a few mad-caps seeking Utopia on earth.—Compressed Air Magazine.

XUM

Changing Design of Machines

UNDER CAPTION "Eliminating Piston Knock" in Aug. 15 issue, I read with interest C. J. Miller's article. Mr. Miller closes by saying: "I think it poor policy to try to change the design of machinery after it has been tested and proven that the machine is capable of doing the work under the conditions to which it is subject."

This idea is a worthy one and may apply to many a case; but when a piston is so loose that it lifts, I believe in putting in a larger bullring that will fit, or plugging as I suggested.

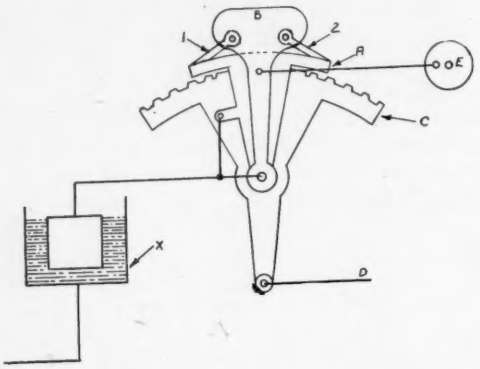


FIG. 1. MECHANISM FOR REGULATING FORCED DRAFT FAN ENGINES

The design of the apparatus is not being changed, but repairs are being made to gain an end.

In the case of which I told, the cost of a new piston casting without machine labor would have been approximately $60 and labor would have brought it to nearly $100. The cost of plugging was less than $10 and the service obtained was satisfactory. The piston packing was snap rings.

Some of us are employed for the purpose of improving the machinery in our charge and I can cite several cases where changes have been made in tried and proven machinery that has increased both production and efficiency.

Sometimes slight changes in design improve power machinery wonderfully although this machine may have operated for years without a skip.

Last winter I changed certain parts of a large engine that had been operating for over twenty years. It is now more efficient.

A method that was employed with more or less success to obtain balanced draft may interest the readers.

Perhaps some of the readers may be familiar with the old pawl and ratchet type water wheel governor from which this mechanism to control the draft was perhaps copied. The accompanying sketches will serve to explain the principle of operation. In Fig. 1, X is a seal with float connected to fire box or combustion chamber; E is a disk crank operated from fan engine which reciprocates arm B carrying pawls 1 and 2; C is a ratchet segment connected with fan engine throttle through rod D; A is a cam plate operated by the float; A, B and C are on the cam pin.

When the float level changes, due to a draft change in firebox or combustion chamber the cam plate is partially rotated; this movement uncovers ratchet teeth which the pawl then engages, turning the ratchet segment and opening or closing the throttle valve more or less.

Figure 2 shows the compensating gear. As float goes up D is the fulcrum, but when ratchet begins to move D lowers and pulls cam plate anti-clockwise, which lifts the pawl and prevents further movement of ratchet. In this particular case, the damper regulator handled the uptake and the mechanism referred to controlled the forced draft.

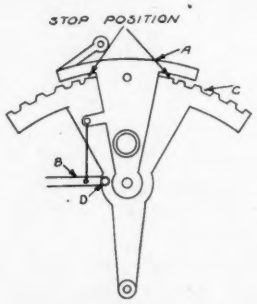


FIG. 2. COMPENSATING GEAR ON DRAFT REGULATING MECHANISM

I prefer to let the steam pressure control the draft (forced) and the balancing mechanism the uptake. The omission of notches in the center of the ratchet segment automatically provided open and shut stop as shown.

TOM THUMB.

A Saving of Twenty Tons of Coal

THE HIGH COST of coal and the large amount that was being consumed in furnaces of a large power plant, was getting on the nerves of the management and the operating force; on two or three different occasions, they were on the verge of shutting down on account of slow shipments and difficulties of getting coal from the mines.

In making an inspection of the plant it was found that all the dampers in the breeching from the boilers

were tied wide open and in two there were no dampers at all. The boilers were equipped with Murphy furnaces; the grates were badly burnt, which let a great deal of the fine coal drop through to the ash pit and sifting boxes. This coal was shoveled out of the boxes and thrown out on the ash pile. The coking plates and pusher boxes on two of the furnaces were burnt and warped so that the coal had to be poked down through or pulled into the furnace with a rake from the inside; when this was done, there was a great deal of green coal pulled onto the crushing bar and when this got too thick, the fireman would shake it down into the ash pit.

The arches and setting were in a depreciated condition as to brick being out and cracks which admitted a large amount of excess air to the furnaces and heating surfaces; the steam pipes from the boilers to the main header were bare and on four of the boilers the packing on the joints from the automatic valves was leaking to such an extent that it sounded as though the boilers were blowing off; the feed-water lines were bare and two of the feed-water regulators were shut off, causing the boilers to be fed by hand; most of the piping throughout the plant was leaking and bare of covering. This plant has a large number of steam traps and most of these were out of order; the returns from the heating system were allowed to go to the sewer instead of being returned to the receiving tank; the steam jets that are used to soften the clinker at the crushing bar of the furnaces were piped from a live steam line; the engines carry a back pressure of 5 lb. and there was enough exhaust steam being blown to the atmosphere to supply these jets and run a small oil pump.

By installing two damper regulators, repairing the brickwork, putting in new arches in three of the furnaces, stopping the steam leaks, covering most of the steam and hot water piping, repairing the feed-water regulators and steam traps, the coal consumption dropped from 140 t. in 24 hr. to 115 to 120 t.

The engines, pumps and other machinery in this plant are in first class shape. The management has inserted a new rule in its working laws which reads, "All work in boiler house to be taken care of in preference to other departments of the plant." C. J. MILLER.

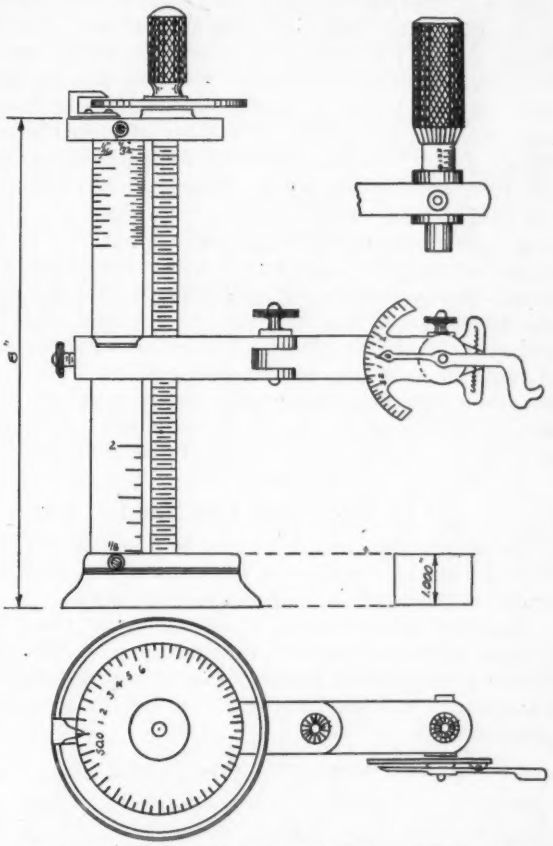
Homemade Micrometer Surface Gage

THIS TOOL was designed for the purpose of gaging the thickness and height of duplicate parts, also for setting planer tools to correct angle and cutting depth. It consists of a circular base, 3 in. in diameter and ¾ in. high, on which is mounted a turntable 2 in. in diameter by ½ in. high, held in place by a ½-in. screw. To this turntable is attached a 9-in. B. & S. steel scale by means of a slot cut in the table and a lock screw. In the center of the table, a ¼-in. hole is drilled to a depth of ⅜ in. in which the elevating screw is guided and held in place.

The instrument holder arm consisting of a piece of ½ by 1 by 3-in. tool steel, is slotted to a sliding fit on the scale and drilled and tapped with a 5/16-20 tap. The portion between the slot and the tapped hole is split with a fine hack saw. One end is machined to receive the swinging extension arm or instrument holder as shown in the sketch. This arm is hardened and ground.

The elevating screw rod is of tool steel 5/16 by 8½ in. long, having 20 threads per inch. To this is attached the dial plate having 50 divisions, and the thimble. After the instrument arm and top connecting plate have been assembled, an indicator of the form shown in the sketch is fastened to the top plate. Clamping screws are fitted on the instrument holder and extension arms for locking them in position.

The extension arm is so arranged as to swing in the hinged joint and can be locked in any position by the lock screws. The outer end of the arm is drilled for a ½-in. hole so as to receive a standard micrometer head and is then cross-drilled with a ¼-in. drill for the indicator shown attached to this tool in the sketch.



DETAILS OF HOMEMADE MICROMETER SURFACE GAGE

It will be evident that this tool has a wide range of usefulness. The usefulness may be further extended by the attachment of a bevel protractor to the extension arm by the use of a small clamp. OTTO DORTHEN.

Are You Efficient?

NOWHERE is there greater need for efficiency than in the power plant. Intelligent thought, foresight and energy are necessary qualifications for a successful engineer. Do you think intelligently or are you one of those chaps who goes through the same routine every day without a thought of what he is doing? If you are, you may make up your mind to the fact that you will go down, instead of up, the ladder of success Or do you think but lack the energy to put your thoughts into execution? Rouse yourself Don't let laziness gain the

upper hand. It is laziness you know—just laziness, nothing more.

If you are a stoker in the boiler plant or an assistant in the engine room, don't decry your lack of promotion and the smallness of your weekly or monthly stipend, but get busy, study your job, improve yourself by studying in your spare time, make yourself more valuable to your employer and you may be sure that ability will be rewarded by suitable advancement and thicker pay envelopes. Above all things, don't let failure daunt you. Keep studying and try again. Gain experience through your failures.

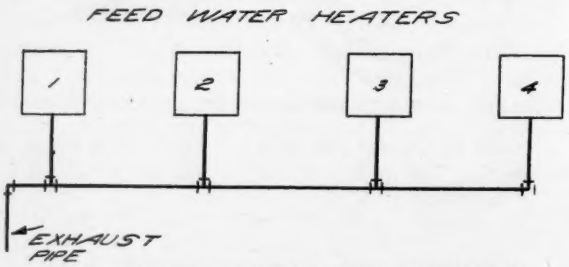
If you are in the boiler room, don't imagine that your job lacks importance. On the contrary, it is one of the most important in the plant. Upon the successful performance of the boilers depends efficient operation of the plant. Don't put off fixing those leaky safety valves and blowoff valves. Deliberate waste is inexcusable. Clean the scale from the boilers and be sure to keep them clean, also the soot from the tubes. Cracked boiler settings, faulty draft control and improper firing all spell fuel waste. This can be reduced to a minimum with proper care. In the engine room there are also many little attentions to the apparatus which will speed up production and reduce expenses. Decreased operating expenses and increased performances will furnish indisputable proof to your employer that you are efficient, and if he is the right kind he will reward you; if not, get out and look for another position. At any rate, the experience and knowledge you have gained will make it much easier to obtain and hold another and better position.

CHAS. R. TIGHE.

The Pipe was Too Small

AN INTERESTING case was called to my attention the other day of an installation of feed-water heaters in parallel as indicated in the accompanying sketch.

These heaters are in use in a large power plant in the East and are operating successfully now, but not until after changes had been made in the piping installed in accordance with the drawings of the feed-water heater manufacturers.



SHOWING ARRANGEMENT OF BEATERS AND PIPING

Generally, it is best to follow the advice of the manufacturer of auxiliary devices, but here is a case where they were wrong.

It was found that with the piping arranged as shown Heater No. 1 "chewed up" too much of the steam, and numbers 2, 3 and 4 didn't have enough to do. As a result the final temperature of the feed water was not high enough.

At first it was thought advisable to run another pipe over to end R and thus reduce the steam velocity to about one-half. Very likely that would have solved the problem.

The method actually used was—enlargement of the header pipe to twice its former size. Each heater now does its full share of the work.

N. G. NEAR.

Factory Water Supply Problem

ON INVESTIGATION the supply of water for toilet and sink use in one of our newly acquired mills was found to come from a pond, as shown in Fig. 1, the pump discharging into three open wooden tanks in the attic of

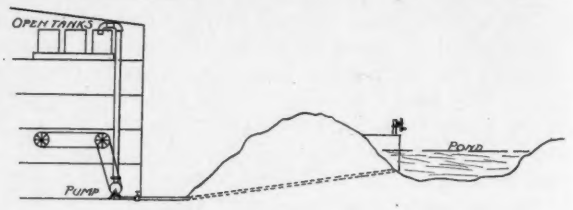


FIG. 1. ARRANGEMENT OF WATER SUPPLY SYSTEM

one of the buildings. It developed that the tanks were old and constantly required attention to keep tight. The expense involved in maintaining the belts, hangers, etc., including labor, with general conditions, made it desirable to pull out the outfit and provide another, and the cost of power for pumping was to be considered, as power was all steam.

The writer decided to put in a hydraulic ram and to make its operation automatic. After installation the cost of operation would be practically nothing and water available at all times.

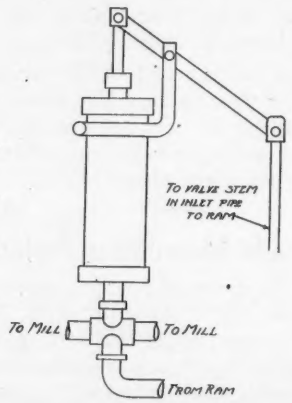


FIG. 2. THE AUTOMATIC CONTROL MECHANISM

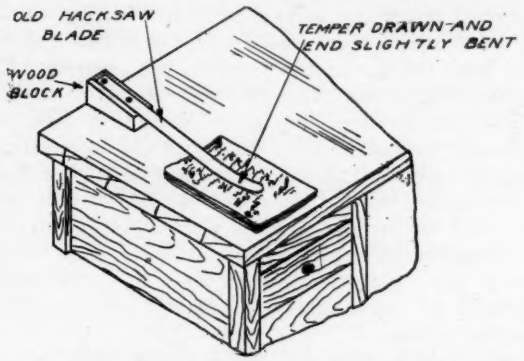
A piece of extra heavy 5-in. pipe, 4 ft. long, was bored out in the lathe and a piston, with two snap rings, made to fit. A band of wrought iron was clamped around the upper end and a lever fitted, as shown in Fig. 2, with a rod connecting to the gate valve of the quick-operating type in the supply pipe to the ram. Operation was as follows: When the draft of water on the system is less than the ram supplies the piston rises and closes the valve in the supply pipe until the demand reduces the head when the cycle is repeated.

RECEIVER.

An Easily Made Paper Holder

THE ILLUSTRATION shows a good holder for loose papers, made from a piece of a discarded hacksaw blade, two small screws and a small block of wood.

This device is very useful, especially around the



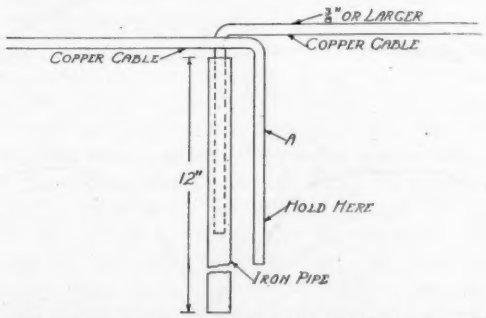
SHOWING THE HOLDER FASTENED TO A DESK

shop, for holding order blanks, time slips, blueprints and the numerous other papers common to the workroom.

ROY H. POSTON.

Connecting Wires

THE WRINKLE herein described is by no means new, but my impression is that on account of its very simplicity nobody has thought to describe it. I have never seen it explained in print.



METHOD OF TWISTING ENDS OF END CONDUCTORS TOGETHER TO MAKE AN ELECTRICAL CONNECTION

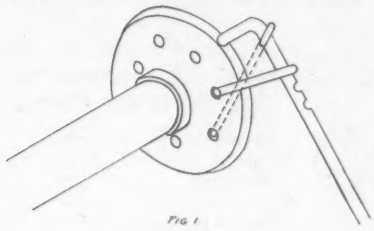
In twisting heavy, solid copper wires together in forming a joint, considerable power is required to bring the coils tight and close together. Special tools are made and sold for doing this class of work.

Using a piece of ordinary iron pipe as a lever, a very satisfactory piece of work can be done. First bend the ends of the cable at right angles as shown, slip a piece of iron pipe (not too loose) over the end of one of the cables; hold down on the other end, as at A. Now draw forward and around the end in the pipe; the result is a tight, close coil. As the coils are formed, the pipe automatically moves back toward the end, thus the worker has a leverage of 12 in. right up to the last coil.

When one side is done, the coil is held by a pair of pliers, or other tool, and the process repeated with the end of the other cable. JOHN THORNE.

Flange Wrench

THE FLANGE wrench, shown in Figs. 1 and 2, will do good work and is easy to make. One point about it is that the pull is on both sides of the flange. With



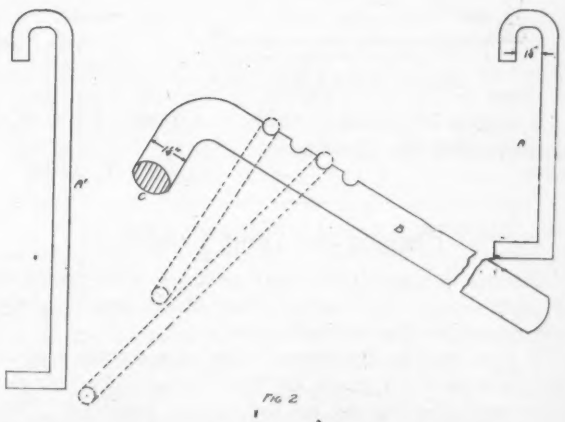
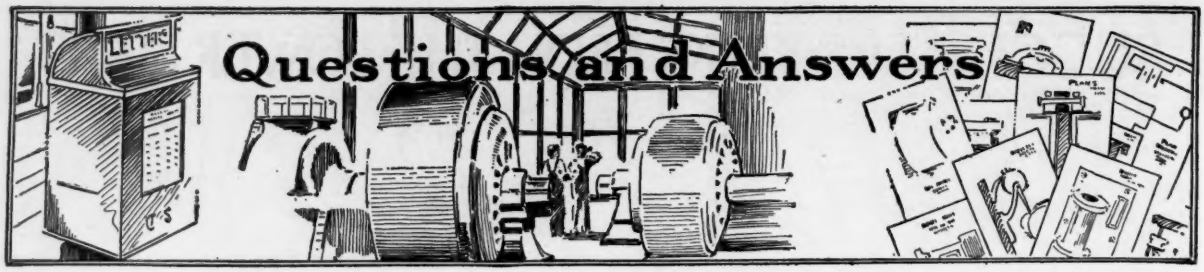


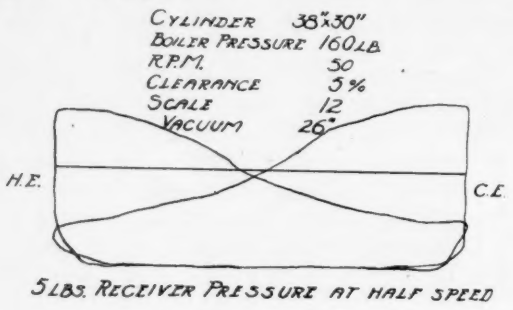
FIG. 1. METHOD OF USING FLANGE WRENCH
FIG. 2. DETAILS OF FLANGE WRENCH

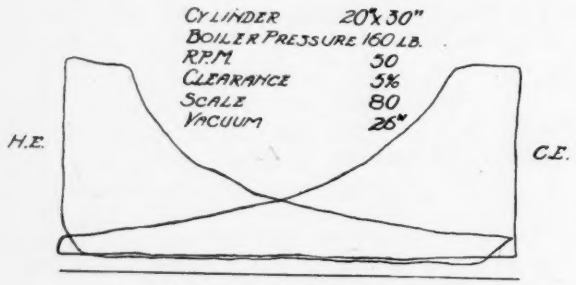
many flange wrenches, the pull is all on one side. The handle is a 1¼-in. steel bar. Heat and bend one end and file teeth in the end, C, file four circular notches along the top near the short bend; with a piece of ⅝-in. bar form them as AA¹; temper the teeth and the wrench is complete. Figure 1 gives an idea how the wrench is used. JAMES SCOTCH.



Indicator Cards for Criticism

THE ACCOMPANYING cards were taken from a 20 by 38 by 30-in. tandem compound, two-stage air compressor. The engine has been in operation for the past 7 yr. and has given very good service.





AIR COMPRESSOR CARDS FOR CRITICISM

I would like to have readers of Power Plant Engineering criticise these cards.

R. J. R.

Purging the Brine Cooler

KINDLY tell me how I may purge a brine cooler of the dead liquor which accumulates at the bottom of the cooler and get it over to the absorber.

I have purged the brine cooler of a certain absorption machine many times, but have been told by refrigerating engineers that my method was not practical. That is why I ask your opinion. J. B.

A. Often, in trying to force the work of the brine cooler, more liquid ammonia will be admitted than the absorber will take care of. This excess liquid will accumulate and the efficiency of the cooler is reduced.

In some systems, the purge line connects from the bottom of the cooler to the liquor line of the pump. With this connection, the purging can be done quickly and the temperature of the brine will, as a rule, be lowered as the liquid is pumped out.

The valve on this purge line must be just cracked at first and then opened just enough so that the operation of the pump is not affected by the handling of too much strong liquid.

Another way of getting the liquid out of the brine cooler is to close the outlet ammonia valve of the cooler and open the purge valve that is in the line connecting the bottom of the cooler with the vapor line running from the top of the cooler to the absorber. This way of purging will cause the temperature of the brine to rise; but the loss will be gained back in a short time, as the performance of the cooler will be more efficient after the accumulation of liquor has been withdrawn.

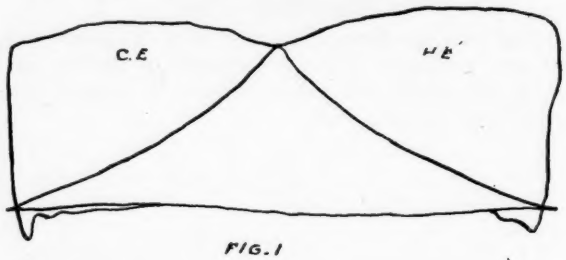
The outlet valve of the cooler can be left open while the purge line is used, but this makes the purging slow.

An independent purge line can be run from the bottom of the cooler to the absorber and by its use the operation of the cooler is not affected much while the purging is done.

Purge often and the efficiency of the cooler will be kept high at all times. A. G. SOLOMON.

Suggestions for Improvements Are Wanted

I WOULD LIKE to have the readers of Power Plant Engineering examine the indicator cards, shown here-



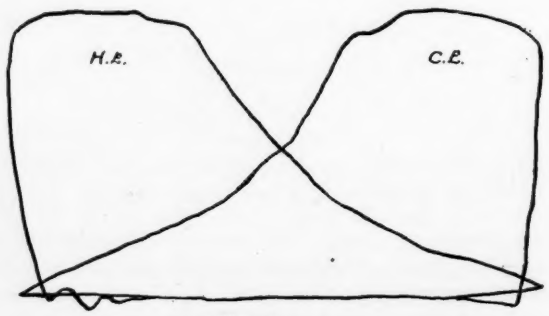


FIG. 1. STEAM CYLINDER
FIG. 2. LOW PRESSURE AIR CYLINDER

with, which were taken from a Laidlow-Dunn-Gordon air compressor and offer criticisms on the weak points and also suggest alterations in the engine that would result in an improvement.

The steam cylinder is 17 by 42-in., boiler pressure 134 lb. gage, r.p.m. 84. The low-pressure air cylinder is 30 by 42 in. ENGINEER.

Heating Problem Solution

I HAVE CHARGE of a 100-hp. heating plant serving two buildings, and a pump in each building to pump water in a boiler. The larger building has about 40,000 sq. ft. of floor, and the smaller about 15,000 sq. ft. The small plant's vacuum runs from 15 to 18 lb. and heats up fine, but in the larger building I cannot get over 6 lb., and when steam is low, it is lower than that. How can I get more vacuum? How much ought there to be?

I am of the opinion that I have not enough steam to operate my pulsometer. I have 1 in. of steam from boiler, a ¾-in. pipe of that running to pump, then 2¾-in. pipe connected to pulsometer, which is ¾ in. double all over; out flow 1¼ in., which goes in the sewer. Should there not be more steam from the boiler to operate it and then the exhaust be turned on the building?

The system works best when I have from 40 to 60 lb. of steam on boiler. I have to have 20 lb. to operate pumps and at that low pressure I cannot hold the water in the boiler. S. L. S.

A. From data given, the writer understands that there are two steam-driven vacuum pumps, one for each building, and these vacuum pumps must discharge into an air separating chamber in order to get rid of the air.

The pulsometer, we assume, takes the return water from the separating chamber and forces it into the boiler. It would be impossible for the steam-driven vacuum pumps to return the water directly to the boiler from which the steam to drive the pumps was taken, as the steam cylinder of a vacuum pump is generally smaller than the water end for reasons of economy.

The vacuum to be carried on a heating system should be just enough to insure that all of the coils and radiators heat perfectly, and no more. The object of the vacuum is to take away the air pressure in the radiators and coils so that the steam may pass into them without resistance and to create a difference in pressure between the supply and return pipes. There are several reasons why the vacuum might be low in the larger system, among which are these: The pump may not be large enough, or in need of attention; that is, the valves may leak or the piston may need packing; there may be numerous air leaks in the system; or the vacuum valves may be leaking through, thereby letting steam directly into the returns. The remedy for this is to look over the valves and clean or repair them. We cannot give directions for the care of the valves or radiator traps until we know the type of valve used; but many times when the steam is found blowing through the valve, the trouble is with scale or dirt in the valve. Cleaning the valve will be all that is necessary.

Tighten stuffing boxes of the radiator inlet valves and pack them where necessary. This will not help the vacuum if pressure is carried on the radiator; but even with pressure on the system, there is a probability that the radiators farthest away from the boiler do not always have pressure on them. This is assuming that the boiler pressure is reduced to 1 or 2 lb. for the heating system.

If the returns come to the pumps too hot, the vacuum will be low and if cleaning and repairing the radiator traps does not help this, it will be necessary to connect a cold water pipe into the suction of the vacuum pumps and run cold water in to cool the returns. They should not be cooled below 160 deg. F., however, unless a very high vacuum is required, and usually 10 in. is enough.

There would not be enough exhaust from your pulsometer to warrant discharging into the heating system, as the steam condenses after discharge of water.

S. E. BALCOME.

Engine Operation

I HAVE A FEW questions I would like to have answered.

1. What kind of cylinder oil is best suited for steam engine?
2. What is a multiported valve and why is it used?
3. How should a boiler patch be put on so as not to require a reduction in the working pressure of the boiler? What shape should it be?
4. Why is a balance plate used on a slide-valve engine?
5. How do you figure the efficiency of an engine?
6. At what point should the low pressure cylinder of a cross-compound engine cut off?
7. How do you figure the ratio of expansion?
8. What should the receiver pressure be in this engine? J. P.

ANSWERS

IF YOU are using wet steam, a compound coil is good because mineral oil does not adhere well to wet surfaces. The oil for this purpose should contain a small percentage of tallow. For use with super-heated steam, the percentage of animal oil should be reduced.

2. A multi-ported valve is one so arranged that there is more than one opening available for the passage of steam at the same time. They give a more rapid opening of the valve with consequent less wiredrawing.

3. It is seldom possible to put in a patch that does not necessitate a reduction in the working pressure of a boiler. In some cases, however, a half moon or triangular patch may be designed with this object in mind. The shape depends entirely on the shape of the bag. A patch is invariably put on the inside.

4. A balance plate on a valve relieves the pressure on the back of the valve and therefore reduces the wear and the power necessary to move it.

5. The efficiency of an engine is equal to the horsepower input (as measured by a prony brake) divided by the horsepower input (determined from the indicator card) which is mean effective pressure times length of stroke in feet times area of piston in square inches times number of strokes per minute, divided by 33,000.

6. The volume at cutoff in the low-pressure cylinder should equal the volume at cutoff in the cylinder

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of next highest pressure divided by the ratio of the densities at these two points.

7. Commercially the ratio of expansion is the ratio of the volume of the low and high pressure cylinders divided by the per cent cutoff of the high pressure cylinder.

8. The pressure in the receivers should be such that the power developed in each of the cylinders should be about the same. Assuming that the mean effective pressure in the high-pressure cylinder bears the same relation to the throttle pressure as the mean effective pressure of the low-pressure cylinder bears to the second receiver prssure, the second receiver pressure should equal the throttle pressure times the ratio of the area of the high pressure cylinder to that of the low pressure.

Boiler and Engine Questions

How MANY pounds of steam at 100 lb. absolute pressure would be required to melt 20 lb. of ice at 24 deg. F.?

2. The area of a safety valve is 10 sq. in. The distance from the fulcrum to the point of attachment of the valve stem to the lever is 3 in. The weight of the lever is 12 lb., and its center of gravity is 18 in. from the fulcrum. If the ball is 33 in. from the fulcrum and weighs 72 lb., at what pressure will the safety valve blow off?

3. In a double zigzag-riveted butt joint with two cover plates, the pitch of the rivets is 4⅛ in. The rivet holes are 15/16 in. in diameter and the plate is ¾ in. thick. If the ultimate tensile strength of the plate is 58,000 lb. and the shearing strength of the rivets is 40,000 lb., what is the efficiency of the joint?

4. (a) What is the principal cause of smoke? (b) How can the production of smoke be reduced to a minimum? (c) Name the three principal conditions required for the complete combustion of coal.

5. How are the following faults shown by an indicator card: Leaking valve; excessive compression; absence of lead?

6. Explain why a Corliss valve gear with one wrist-plate cannot cut off between about one-half stroke and a point near the end of the stroke. U. H. B.

ANSWERS

ASSUMING that there is no loss of heat with the required 2.51 lb. of steam to melt 20 lb. of ice at 24 deg. F., the specific heat of ice is 0.504 and the latent heat of fusion of ice is 143.6 B.t.u. It is necessary in this case to raise 20 lb. of ice through 8 deg. and this would require 200×0.504, or 100 8 B.t.u. In order to melt this ice at 32 deg. F., it requires 20×143.6, or 2872 B.t.u. The total amount of heat required, therefore, to melt 20 lb. of ice is 2972.8. One pound of steam at 100 lb. pressure absolute contains 1186.3 B.t.u. Therefore, dividing this figure into the amount of heat required to melt 20 lb. of ice gives 2.51 as the answer.

2. The pressure at which a lever and ball safety valve will blow off is figured by means of the following formula:

$P = (WL + wg + Vl) \div Al$

P = Pressure in lb. per sq. in.
W = Weight of ball.
L = Distance from fulcrum to center of ball
w = Weight of lever
G = Distance from fulcrum to center of gravity of lever
V = Weight of valve
l = Distance from fulcrum to center of valve
A = Area of valve in sq. ft. in.

As you do not give the weight of the valve and its stem, we will assume that to be 3 lb. Substituting then in the above formula, we have

$$P = \frac{(72 \times 33) + (12 \times 18) + (3 \times 3)}{10 \times 3} = 86.7 \text{ lb.}$$

3. The strength of the unit of the solid boiler plate is found by means of the formula $P \times T \times S = ST$. Where P is the pitch of rivets in inches, T the thickness of the plate, S the tensile strength in pounds per square inch and ST the strength of the unit of a plate. Substituting the given data, we have

$$4.125 \times 0.75 \times 58.000 = 179{,}500$$

The strength of the plate between rivets equals $(P - D) \times T \times S$. Where D is equal to the diameter of the rivet and the other letters the same as in the preceding formula, substituting, we have

$$(4.125 - 0.9375) \times 0.75 \times 58{,}000 = 134{,}400$$

The shearing strength of the rivets is equal to $N \times S \times A$. Where N is the number of rivets in the single rivet unit, S the shearing strength of the rivets and A the area of the cross-section of one rivet. Substituting, we have

$$3 \times 40{,}000 \times 0.6903 = 82{,}800$$

As the strength of the rivets is less than the strength of the plate between the rivets, this formula is used in figuring the efficiency of the joint and is to be divided by 179,500, giving an answer of 46.2 per cent efficiency.

4. (a) The principal cause of smoke is incomplete combustion. (b) The production of smoke can be reduced to a minimum by the use of a properly designed furnace and a proper supply of air or exygen. (c) The three principal conditions required for complete combustion of coal are: (1) sufficient air, (2) large enough combustion space to prevent cooling of the gases before they are completely burned and (3) the air must be warm before mixing with the gases.

5. A leaking valve would cause the expansion line to show too high pressure at the end of the stroke. Too much compression would cause a loop at the admission corner of the diagram. Absence of lead would cause the nominal admission line to drop immediately after the commencement of the stroke, rising again when admission actually occurs.

6. The eccentric on a single eccentric Corliss engine is set 90 deg. more or less ahead of the crank. The valve, therefore, does not start to open until the eccentric has passed through 90 deg. and has moved the valve rod through one-half of its travel. By the time the piston will have traversed one-half of its stroke, the eccentric will have reached the end of its stroke. As the cutoff is controlled by the governor which must act while the eccentric is on its forward part of the stroke, the cutoff must take place before the eccentric has reached the end of its travel, at which time the piston is about midway of its stroke.

Wind Pressure on Smokestacks

IN A NEWSPAPER I recently saw an article copied from one of the leading motor magazines which stated that

"A man walking at the rate of 4 mi. an hour has a pressure of ½ lb. against him provided the air is still"—and then goes on to say the same man walking at the same speed against a 30-mi. gale has a pressure of 26 lb. against him. I do not see how they figure this, but would like to ask the following questions: If a structure, say for instance a tall building or a square smokestack, presented a flat surface directly to the wind blowing at 30 mi. an hour, what would the pressure be per square inch against the surface?

For the sake of argument and if such a thing were possible, suppose that the building or stack could be moved rapidly against the 30-mi. wind at the rate of, say, 4 mi. per hour, in this case what would the pressure per sq. in. be? As this brings up the matter of wind resistance in structures so exposed, a little discussion along this line may prove instructive as well as interesting. C. L. R.

A. Velocity is a purely relative quantity. The relative velocity between a surface and the wind, say, is the same whether the wind is doing the moving or the surface is moving at the same rate against a calm. In your case, pressure on the stack would be due to a 34-mi.-an-hour wind or velocity.

The article you saw is approximately right depending on the coefficient used.

The pressure created by wind on a surface is usually given in the form

Where $P = KV^2$

P = pressure in lb. per sq. ft.

V = velocity in miles per hour

K ranges from 0.003 to 0.005 depending on the authority.

Using an average value of K, the pressure due to a 30-mi. wind is found to be 3.6 lb. per sq. ft. and for a 34-mi. wind, 4.6 lb. per sq. ft.

Corliss Valves and Boiler Joints

I HAVE BEEN puzzled for some time for answers to the following questions. Will you kindly answer them?

1. Why are there laps on the steam valves of a single eccentric Corliss engine?

2. Why is the widest strap of a butt joint on the inside of the shell?

3. How do you figure the efficiency of a quadruple riveted butt joint? H. N. D.

ANSWERS

A SINGLE ECCENTRIC Corliss engine valve has no lap in the sense that a slide valve has lap. What is in effect a lap, however, is the overtravel of the crab claw before it moves the valve. If it were not for this fact, admission would occur much earlier, probably about half stroke, or cutoff would be nearly full stroke.

2. The widest strap of a butt joint is placed on the inside of a shell more from a practical consideration than from any question of design. The shell holds its circular shape better under stress with this arrangement than it would with the narrow strip inside. Good caulking is also more easily accomplished with this design.

3. The efficiency of a quadruple rivet joint is found by dividing the stress at which it will fail first, due to shearing of rivets, tearing the plates between rivets, compression in front of rivets or any combination of these failures, by the stress at which the plate proper will fail. The first step is to find the manner in which the joint is most likely to fail.

A typical section of such a joint contains six rivets on each side of the butt, two in single and four in double shear.

Shear: $F_1 = (4 \times 1.8 + 8)\ 0.7854d^2\ u_s$.

Tension: $F_2 = (p - d)\ t\ u_t$.

Compression: $F_3 = (4\ dt + 2\ dt_1)\ u_c$.

Tension of unriveted sections: $F = p\ t\ u_t$.

The least of F_1, F_2, or F_3 divided by F and expressed in per cent will give the efficiency.

Where d = diameter of rivet

p = maximum pitch

t_1 = thickness of inner strap

U_s, v_t, v_c = respectively ultimate strength in shear of rivet, and tension and compression of plate.

Calculating Boiler Horsepower

CAN YOU tell me how to calculate the horsepower of a boiler? And that of a steam engine? A. S.

A. Standard boiler horsepower is found by means of the following formula:

$$Hp = \frac{W \times (H - T + 32)}{33{,}350}$$

Where Hp = horsepower

W = weight of water in pounds actually evaporated per hour

H = total heat of the steam above 32 deg. F. at the pressure of evaporation B.t.u.

T = temperature of the feed water.

The horsepower of an engine is found by means of the following formula:

$$Hp = \frac{PLAN}{33{,}000}$$

Where P = mean effective pressure in pounds per square inch

L = length of stroke in feet

A = area of the piston in square inches

N = number of working strokes (twice the number of revolutions in a double-acting engine).

Meter Capacity

CAN YOU estimate closely the size meter for house lighting by the number of lights in the house? J. D. O.

A. Ordinarily, gas meters are rated by the number of lights which they are to supply. The light used as a standard is the ordinary 2-ft. open burner and the number of lights which the meter is to supply at any one time determines the size of the meter. Electric meters, on the other hand, are usually rated by the number of amperes which they are to pass. Both types of meters are capable of withstanding about 100 per cent overload without damage.

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CONTENTS

The Plant of the Powers Regulator Co. Illustrated.....967

Eliminating Water Hammer in Heating Systems. By Charles L. Hubbard. Illustrated.....972

Power. By J. M. James.....974

Stocks and Production of Bituminous Coal. Illustrated..975

Horizontal Tubular Boiler Settings and Details of Installation. Illustrated.....979

Great Western Power Plants to Double Present Capacity. By Charles W. Geiger.....982

Some Notes on Pipe Covering. By Charles L. Riecke. Illustrated.....983

New Mechanically Operated Gas Producer. Illustrated...984

Using the Graphic Meter. By Victor H. Todd. Illustrated.....987

Novel and Handy Electrical Test Instrument. By C. W. Eisenmann. Illustrated.....990

Safety Methods Used in Welding.....992

Sketching. By S. C. Swanson. Illustrated.....993

Actualities in Industrial Russia of Today.....996

Letters Direct from the Plant: Changing Design of Machines. A Saving of Twenty Tons of Coal. Home-made Micrometer Surface Gage. Are You Efficient? The Pipe Was Too Small. Factory Water Supply Problem. Illustrated.....1000

Successful Kinks from the Power Plant: An Easily Made Paper Holder. Connecting Wires. Flange Wrench. Illustrated.....1003

Questions and Answers: Indicator Cards for Criticism. Purging the Brine Cooler. Suggestions for Improvements Are Wanted. Heating Problem Solution. Engine Operation. Boiler and Engine Questions. Wind Pressure on Smokestacks. Corliss Valves and Boiler Joints. Calculating Boiler Horsepower. Meter Capacity. Illustrated.....1004

Editorial: How's Business? Our Coming Power Development.....1008

High-Voltage Motors for Floating Dock. Illustrated...1010

New Type Oil and Water Strainer. Illustrated.....1010

Low Level Multi-Jet Condensing Plant. Illustrated.....1011

Organization Meeting of the Federated American Engineering Societies.....1012

News Notes.....1012

Book Reviews.....1013

Trade News.....1013

How's Business?

With slowing down of factories in some industries and short time in some localities, the question naturally comes, are we due for a period of "dull times"? Opportunely two answers are forthcoming, one from the Chamber of Commerce of the U. S., the other from the survey made by the Fidelity and Deposit Co. of Baltimore, Md.

In the latter is given a bird's-eye view of business and financial conditions in all parts of the country, the information being gathered by telegraph from a questionnaire and investigation conducted by the company's representatives, and summarized as of Sept. 15. The former is from Archer W. Douglas, chairman of the committee on statistics and standards of the Chamber, gathered from the local chambers of commerce and from reports by government departments and representatives. In essentials the reports agree as to general conditions.

Prospects for winter business are considered Fair to Good by wholesalers and retailers in all parts of the country except New York, New Jersey and Pennsylvania, and manufacturing plants are well filled with orders, though New England reports some cancellations. There is no shortage of raw materials which will curtail production; but there is shortage of coal and of freight cars at all points, though in varying degree. The mountain states are best fixed of any as to coal and have only slight shortage of cars. Transportation conditions are improving in all sections and car shortage is being slowly reduced.

Crops are good and the farmers well supplied with funds, though in the wheat belt and mountain states there is a large amount of unsold crops.

Labor conditions have changed little. There is apparently no shortage of labor nor is there unemployment, but productivity per man is not increasing and costs of manufacturing are high, running from 10 to 50 per cent greater than in 1919. This is a weak spot in the industrial structure, and will need a change before the business of the country gets to a sound basis.

Banks seem to have funds at 6 to 10 per cent, but are well loaned up and not seeking opportunities. This results in industrial concerns carrying a large amount of customers' paper, but in spite of this they are, as a rule, discounting their bills. Collections are, however, more difficult than for many months, and if this condition continues, it may result in essential curtailment of credits. Banks are handling an increasing number of accounts, both commercial and savings, and report that deposits are increasing.

It is predicted by Mr. Douglas that the peak of high prices and business activity is past, that we are entering on a period of readjustment, which, though long, will be without disastrous results. Buying is liberal, but is more sane than heretofore and free from speculation.

Condition of farmers is satisfactory because in nearly all sections diversification of crops is now practiced. Wool is plentiful, and prices are low; beef cattle are in good condition, but prices are too low to pay for the present high cost of feeding. There is likelihood, however, of plentiful supply of forage and hay, which will help to solve the livestock problem, even at lower prices for the cattle.

Wheat, while not so heavy as seemed likely in the

spring, is abundant; but the situation is complicated by the inability of elevators to handle the grain. They are filled, cannot get cars to ship out, hence cannot take grain from the farmers who have no place to store it and in some cases are forced to sell for what they can get to meet obligations. This has lowered the market price.

Cotton is doubtful because of the wet season, but it is expected that there will be sufficient to prevent scarcity.

Two spots in the industrial field show a slump. The automobile industry has fallen off and a period of lower prices is here. Also building is nearly at a standstill, due to high cost of materials, difficulty in getting them and the high price and unreliability of labor.

As a summary, a readjustment has started. Prices are gradually decreasing, and if workers and employers co-operate in the readjustment of prices and wages, each being willing to make sacrifices to bring industry back to a normal and stable basis of prices and wages, the result can be accomplished, in time, without serious disturbance to business. If either party resists the inevitable readjustment, it may result in a long struggle which will have at least uncomfortable reaction on industry for many years to come. Co-operation,—increase of production, taking somewhat less profits and somewhat less wages, spending less on luxuries and saving more,—will all help.

Our Coming Power Development

Main reliance for power throughout the country has been, is and will be on coal. But we are facing new conditions and a new line of development is inevitable and desirable.

Anthracite, except in a limited area and limited amount, is unavailable for power plants. The mines are bunched in a comparatively small area; big hauls are expensive; demand for domestic use exceeds supply and we have already used 2.8 billion tons, leaving only 19 billion tons underground. Hard coal may, therefore, be dismissed as a factor of the future in power manufacture.

Of bituminous coal, we have used 9.2 billion tons, but there is left underground 1500 billion tons in the United States proper and 150 billion tons in Alaska. No danger of failure of our bituminous supply is to be feared, but cost of production is jumping upward; the price of bituminous at the mines has increased about 175 per cent since 1914, and cost of delivery to the power plants by nearly as large a percentage. Further, our means of transporting coal have not increased in anything like the proportion of the demand for coal, so that difficulty of delivery becomes steadily greater. In 1918, we mined 700,000,000 tons with the demand increasing 50,000,000 tons a year, over 7 per cent, and two-thirds of this coal is used for power in plants and on railroads and steamships. Increased development of coal-using plants must be increasingly difficult, because of the problem of getting coal to the plants and the high cost of the fuel at the plant.

Fuel oil can be of but slight assistance. In 1919, we produced 356,000,000 bbl. and imported 70,000,000. The railways used 45,700,000 bbl. in 1918 and the Navy will soon require 100,000,000 bbl. a year, leaving 280,000,000 bbl. for industry, less the amount taken for gasoline and lubrication. A large part of this goes to processes which cannot well use coal as fuel; the balance will care for but a small percentage of the power requirements of the country, usually at a cost as great or greater than that for coal, and with at least as great difficulty in getting a supply.

One other source of power has been placed in position by recent legislation for permanent and profitable development. Water powers require a large initial outlay for dam and plant, which cannot be made unless a return for a considerable period is assured. But cost of operation is comparatively small, and the supply of power is definite, if the development has been wisely carried out.

In the eastern part of the country, a considerable portion of the available power has been developed, over three-fourths in New England and about one-third in the other territory east of the Rocky Mountains. This is in part because of land conditions, the power sites not being controlled by government, and in part because greater concentration of population makes possible short transmission lines. There is, however, available the undeveloped two-thirds in the South Atlantic and Central states, amounting to 11,000,000 hp., which can now be developed under supervision of the Federal Power Commission; and in the Mountain and Pacific states, there is available 38,000,000 hp. in a region where coal deposits are of low grade or at remote points.

In the East, interconnection of hydraulic systems, and of steam plants at the mouths of coal mines is proposed as an economical solution of the fluctuation of water supply and transportation of coal. In the West, tremendous hydraulic plants, interconnected and transmitting over long distances are no novelty, and development of this method to a vast network may be looked for. These things are *big*. They cannot be accomplished in a year, but they have great possibilities of economy, of permanence, and of saving of natural resources and they are bound to come. The power survey now being made for a system extending from Boston to Washington and inland 100 to 150 miles, to take in present development and hydro-electric works and mine-mouth steam plants to be built is one indication. Application for licenses to develop a half-million horsepower of water-power plants, made within a month of the signing of the new water-power act is another. We are looking toward the day of tremendous things in the power plant field, and those engineers who become a factor in this development will make history for the industrial development of the country.

Power Plant Slogans

Store Coal in Summer.
Keep and Analyze Operating Records in Every Power Plant.
Develop Water Power Sites.
Promote Health and Safety in Power Plants.
Handle Coal and Ashes Mechanically.
Employ Engineers for Engineering Work.

XUM

High-Voltage Motors for Floating Dock

ONE OF the most interesting features of the new 10,000-ton floating dock of the W. & A. Fletcher Co., Hoboken, N. J., is the use of 2400-v. motors for operating the pumps.

Heretofore, only low voltage (440 v. or less) have been used on docks; and where high-voltage current is

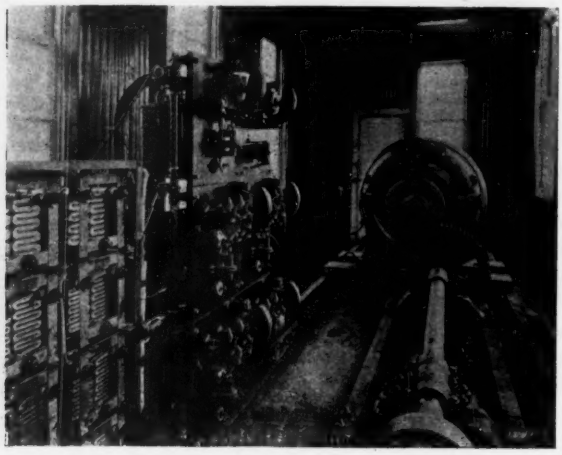


FIG. 1. ALTERNATING-CURRENT MOTORS DRIVING CENTRIFUGAL PUMP THROUGH LINE SHAFT

supplied to the shipyard by a central station, it has always been customary to reduce the voltage by transformers before the power is distributed to the motors and other electrical equipment. But, in the case of the Fletcher dock, a practice that is becoming general in other industries has been followed; namely, to utilize

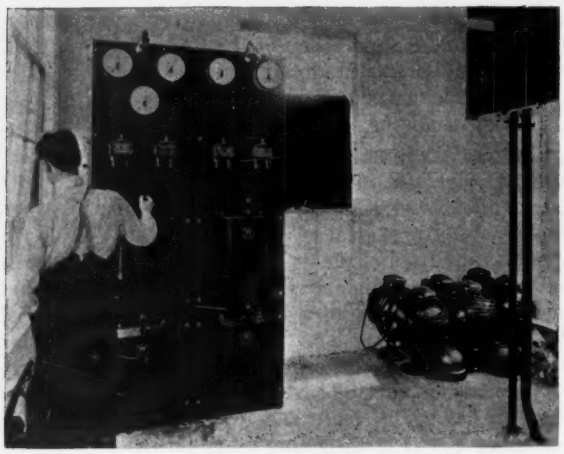


FIG. 2. VIEW OF PANEL BOARD WITH FOUR SMALL MASTER CONTROLLERS

the high-voltage current without voltage reduction for large motors and thus reduce the cost of the transformer installation.

The Fletcher dock, which consists of two sections, one of four pontoons and the other of five, is equipped with eighteen 12-in. centrifugal pumps, each with a rated capacity of 2200 gal. per minute and a maximum speed of 500 r.p.m. These pumps are arranged in four groups, one in each wing of the two sections, and each group is driven through a lineshaft by a motor—a 200-hp. motor driving four pumps in each wing of the smaller section. The motors, which are of the variable-speed, wound-rotor type, are located in houses on the wings and are geared to the lineshafts.

Control of the motors is centered in a small brick house on the pier at the end of the dock. Here there is a panel on which are mounted four small master-controllers, one for each motor, and an operator stationed here can start, stop, slow down, or speed up any or all of the pumps as the dockmaster directs. The master-controllers do not control the motors directly, but control the opening and closing of magnet switches, which are mounted on panels in each motor house and make the actual motor connections. Hence the master-controllers do not handle the heavy, high-voltage motor currents for operating the switches. The wiring of the control circuits is inexpensive, and the master-controllers are perfectly safe to handle.

Mounted on the same panel with the master-controllers, are four ammeters, one for each motor, which gives the operator full information as to the performance of the motors and enables him to tell at a glance if all are operating properly.

New Type Oil and Water Strainer

STRAINERS are required on the suction and discharge lines of lubricating oil, fuel oil and quenching oil systems, for the removal of solid foreign material in suspension. Also power plants which secure

FIG. 1. NEW TYPE SINGLE UNIT STRAINER

their raw water supply from such sources as rivers or lakes require strainers to prevent weeds, sticks, marine plants and small fish from entering pipe lines.

For this purpose has the strainer shown in accompanying illustrations recently been designed. The body is constructed of cast iron and the strainer basket of perforated sheet steel and lined with wire mesh when strainer is to be used on an oil line.

This strainer is of the single type and may be installed either as a single unit or in a set, which consists

of two of these strainers connected, complete including two three-way valves and necessary connecting elbows, unions and nipples. This set permits the cleaning of

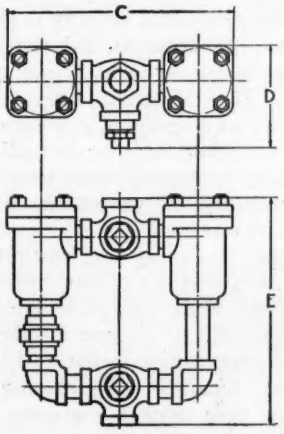


FIG. 2. STRAINER SET WHICH PERMITS CLEANING WITHOUT INTERFERING WITH FLOW

either of the two units without interruption of the service.

Low Level Multi-Jet Condensing Plant

THE MOST striking feature of the low level multi-jet condenser shown in the accompanying illustration is its simplicity. There is only one pump, and that is the standard centrifugal unit which supplies water under pressures to the nozzles of the condenser, instead of the usual type of removal pump under the condenser to handle the discharge.

The water is discharged through a set of nozzles in multiple jets or "ropes" which flow, at high velocity, through a combining tube where the condensation is effected. Steam enters either at the top or side, depending on whether the engine or turbine served discharges at the bottom or side. Cooling water, condensed steam, air and uncondensable vapors are ejected through a Venturi tube in which the pressure is stepped up from the existing condenser pressure to atmospheric. The discharge then flows to a sump, from thence it is picked up by a circulating pump serving a tower or cooling pond, or is allowed to discharge to waste.

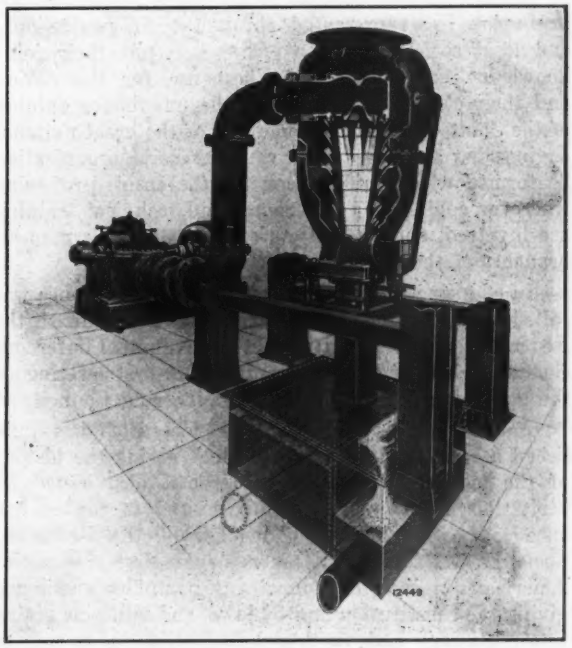
Absolute pressures of 1 lb. in summer and ½ lb. in winter are readily maintained. No air pump is required with this installation, as the action of the ejector evacuates the condensing chamber of air and maintains a high vacuum.

The whole plant is of extremely rugged and simple design. The pump itself is a standard high efficiency split case, centrifugal pump which is easily accessible at all times for inspection and repair. By reason of its handling only cold water under moderate suction lift conditions, the life of the impeller is long as compared to that of impellers removing hot water at high vacuum from the ordinary low level condenser.

The condenser proper is also of extreme simplicity. There are no parts subject to excessive wear or likely to get out of order. The water nozzles are of bronze, as are also the lower rings of the combining tube and the tail pipe bushing. These features result in sustained reliability with a minimum of costly shutdowns for repairs and replacements.

That the air may be removed by ejection with the consequent elimination of an air pump, more water is required with this condenser than with the ordinary type of low level jet condensers. All the water, however, is handled by one centrifugal pump operating under efficient suction lift conditions with its reduced power consumption.

The removal pump of the ordinary condenser works under conditions simulating about a 30-ft. head, which is close to the theoretical maximum where it pumps no water and consequently has zero efficiency.



LOW LEVEL MULTI-JET CONDENSING PLANT

The increased efficiency of the pump on this condenser compensates for the increased quantity of water required; and, in addition, no air pump, with its relatively large steam requirements, is needed.

U. S. CIVIL SERVICE COMMISSION announces an examination for electrical engineering aid to fill vacancies in the Bureau of Mines, Department of the Interior, for duty at Pittsburgh, Pa., or elsewhere, at entrance salaries ranging from $1200 to $1680, and vacancies in positions requiring similar qualifications at these or higher or lower salaries. Competitors will be rated on physical ability, education, training and experience, and must not have reached their fortieth birthday on the date of making oath to the application. Age limits do not apply to persons entitled to preference because of military or naval service. On account of the needs of the service, applications will be received until further notice. Papers will be rated promptly as received, and certification made as the needs of the service require. Apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.

Organization Meeting of the Federated American Engineering Societies

REPRESENTATIVES OF 60,000 ENGINEERS TO MEET IN WASHINGTON, NOV. 18-19, TO COMPLETE ORGANIZATION AND ELECT OFFICERS

SINCE the conference held in June, at which 140 delegates representing 110,000 engineers and over 70 organizations were present, plans have gone steadily forward for completing the organization and getting it at work.

The Federated American Engineering Societies is constituted of engineering and allied technical organizations for the purpose of advancing knowledge and to be of public service. Engineers of every branch of the profession are represented through their professional and local societies, in the purpose to put their joint knowledge and skill to the best use for the nation and their communities. It was the unanimous opinion of the Joint Conference Committee of the great national engineering societies that a comprehensive organization be formed which could speak for the entire profession wherever engineering experience and technical training are involved, and on matters of common concern to all branches of the profession.

In adopting this recommendation, the conference was called, and without a dissenting vote, organized the Federated Societies, authorizing the Joint Conference Committee to act ad interim until the first meeting of the governing body, American Engineering Council.

Acting on this authority, the committee has published a booklet, "Engineers Unite," giving the history of the movement and the conference, also issued an invitation to each organization invited to the conference to become a charter member of the Federated Societies and to send delegates to the first meeting of American Engineering Council. A pamphlet was issued giving the constitution and by-laws, and bulletins giving interpretations and further information in answer to questions which have arisen from time to time.

In these bulletins has been pointed out the service rendered by Engineering Council as organized by the four national societies, and the way in which the new Federated Societies and American Engineering Council, organized on broader and more democratic lines can better serve the interests of the profession and the public. Also the action of societies in applying for charter membership has been recorded. American Society of Mechanical Engineers on June 4, Technical Club of Dallas on June 22, American Institute of Electrical Engineers on June 30, Cleveland Engineering Society on Aug. 10, favorable action by the American Institute of Chemical Engineers on June 28 and by the Board of Direction of the American Institute of Mining Engineers on June 25 and reference to better ballot by its members of the American Society of Civil Engineers on Aug. 10.

It has been explained that any society whose chief purpose is the advancement of knowledge and practice of engineering and allied technical arts and which is not organized for commercial purposes is eligible and may apply for membership in the Federated Societies, as it is recognized that the list reached by invitation is not complete.

In the bulletins, the prestige which will be given to engineering by the Federated Societies over what can be gotten by individual societies is pointed out, the method of financing explained, and the expenses necessary if the profession is to have proper standing in public affairs. The Federated American Engineering Societies will act as a medium in securing such standing, and each individual engineer and allied technologist should be willing to contribute at least $10 a year to attain this result for his profession, although on the basis provided, the average per capita contribution will not be more than one-third that amount.

Notice has been sent out of the meeting of delegates to American Engineering Council in Washington, D. C., Nov. 18-19, which will be the first meeting of the greatest engineering organization in the world. The committee states that American Engineering Council will represent more than 60,000 engineers and technologists, and will have more member societies than Engineering Council with a greater aggregate membership than any other engineering organization. The meeting in November will deal with the future work, and determine the more important problems to receive immediate attention; those in which the profession can be most helpful in rendering service to the community, state and nation.

News Notes

J. W. GARDNER, president of the Gardner Governor Co., Quincy, Ill., has been named national councillor of the Hydraulic Society, to represent it in the Chamber of Commerce of the United States. The National Council of the Chamber of Commerce of the United States consists of one representative each from the more than 1300 commercial and industrial organizations making up the National Chamber's membership. It serves as an advisory body to the National Chamber's Board of Directors. The Council holds a special meeting preceding the annual convention of the National Chamber to pass on the program and to select a nominating committee. The councillors also act as chairmen of the delegates representing their organizations. A councillor occupies a position of liaison between the National Chamber and his own organization on important questions.

THE ELLIOTT CO., manufacturer of power accessories, has moved its headquarters from Pittsburgh to Jeannette, Pa. The general office is to remain at the old address, but the sales office, accounting, engineering, and purchasing departments, as well as the plant, are located at the new address.

ANNOUNCEMENT is made by the American Steam Conveyor Corporation of a change in its corporate name to the "Conveyors Corporation of America."

The change in name is due to the rapid growth of the corporation, the addition of new lines of business and the purchase at South Bend, Ind., of a large and completely equipped machine shop to which foundry facilities will be added.

The new name more nearly describes the present

business of the organization. The acquisition of a new machine shop at South Bend, Ind, will afford unusually prompt service and will meet the strictest requirements of the customers.

There is no change either in the personnel or policy of the company.

THE R. H. BEAUMONT CO., of 319 Arch St., Philadelphia, has recently opened a Pittsburgh, Pa., office at 230 Fifth Ave. Thomas Widdop is in charge.

CHARLES E. PATTERSON, comptroller of the General Electric Co., has been elected vice-president of the company.

MIDWEST ENGINE CO. has removed its New York office from 111 Broadway to 90 West St., New York City. Charles F. Ames & Co. have been appointed as district sales managers for the New York territory and will handle all of the Midwest Engine Co.'s products.

AT A MEETING of the Board of Directors of the Westinghouse Electric & Mfg. Co., it was decided to issue bonds for $30,000,000 and to increase the capital stock by $50,000,000.

This course has been determined upon after analysis of the business of the company and its future prospects, the business having nearly doubled since 1914. Unfilled orders at the present time on the company's books exceed $95,000,000, an increase of about $24,000,000 in 5 mo. This requires a substantial increase in the company's capital to carry enlarged inventories and increased volume of customers' accounts.

A meeting of the stockholders is to be held on Nov. 18 to act upon the recommendation of the directors.

AN ANNOUNCEMENT recently issued by the Worthington Pump & Machinery Corporation, New York, states that it has completed its preparations for the production of motorship machinery, and is now prepared to take and execute orders for complete engine room equipment. A new all-American design of Diesel main propelling engine has been developed and is being subjected to very complete tests at their Snow-Holly Works at Buffalo, N. Y.

A new 2400-hp. six-cylinder marine Diesel engine has been made and is the largest four-cycle engine of this type yet built. The company has embodied in the design of this engine the leading and established principles of some of the most successful foreign builders, and will be able to produce these engines in considerable numbers to meet the growing demand which is now beginning.

RAGNAR CARLSTEDT, a noted Swedish inventor and designer of automatic regulating apparatus, arrived in New York on Oct. 2. He will make his headquarters at Grand Central Palace, New York City, while in this country.

U. S. CIVIL SERVICE COMMISSION announces an examination Dec. 8 and 9, for junior engineer and deck officer, to fill vacancies in the United States Coast and Geodetic Survey at the entrance salary of $2000 a year, and vacancies in positions requiring similar qualifications at this or higher or lower salaries. The salary will be increased to $2240 a year after one month of satisfactory service. Competitors will be examined in mathematics (including trigonometry, analytics, mechanics and calculus); practical computations (involving the use of logarithm tables); modern languages (competitors may select one of the following: French, German, Spanish, extracts of about 125 words being given for translation into English); astronomy (questions in spherical and general astronomy with especial reference to determination of latitude. longitude, time and azimuth, and use of field instruments); physics (questions in optics, magnetism, etc.); surveying (questions in plane and geodetic surveying and on the use of field instruments). No sample questions will be furnished. An applicant must not have reached his twenty-sixth birthday on the date of the examination. Age limits do not apply to persons entitled to preference because of military or naval service. Apply for Form 1312, stating the title of the examination desired.

Book Reviews

THERE HAS recently been published by the Government Printing Office at Washington, D. C., a 288-page book, entitled "The Naval Consulting Board of the United States," by Lloyd N. Scott, which gives in narrative form an account of the origin and achievements of this board, which was created in 1915. Many of the most interesting inventions of the war, with illustrations, are described in this volume, including the work of Thos. A. Edison, who is president of the board. It also sets forth the returns from the mobilization of the inventive talent of the country as well as the Industrial Preparedness Campaigns of the board and the origin of the Council of National Defense.

If a demand for copies justifies, the Superintendent of Documents, Government Printing Office, will issue a sales edition and applications for copies should be made to that office.

THE DEPARTMENT of Engineering of the Johns Hopkins University has recently issued a 225-page book, entitled "The J. E. Aldred Lectures on Engineering Practice, 1919-20." This course of lectures, delivered at the Johns Hopkins University, is one feature of a general plan, made possible by a gift from J. E. Aldred, for furthering and improving undergraduate instruction in the methods and problems of the practice of engineering. The lectures, therefore, deal with the practical phases of engineering problems, rather than with underlying theory. They do not aim to discuss new and striking applications, as much as to deal with every-day working methods of design, construction, and operation.

Trade News

THE DEVELOPMENT of Standard Unit Switchboard Panels by the General Electric Co., described in Bulletin 47,001-A, second edition superseding Bulletin 47,001, resulted after comprehensive study, classification and co-ordination by engineering experts of data on recurring conditions over a large number of installations. Selection has been facilitated by general uni-

formity of standard specifications; economy and efficiency have been combined through quantity production, and the greatest advancement based on experience has been vouchsafed in the unit panel system.

In general the panels comprise units for (a) small capacity plants, d.c. for one or more generators not larger than 240 kw., for mining service, grounded negative, and for three-wire lighting, grounded or ungrounded; a.c. for 240 and 480 v. with lever switches, for 480 and 600 v. with oil circuit breakers, for 1150 and 2300 v., and for series incandescent and series arc service. A and (b) for large capacity plants, d.c. with double polarity, generator and feeder panels, and for railways service up to 1500 v.; a.c. for induction motor starting and controlling, for 240, 480 and 600 v. with oil circuit breakers on panel, for 240, 480 and 600 v. with oil circuit breakers on framework, for 1150 and 2300 v., and the removable truck type, safety enclosed.

A number of representative switchboards are illustrated and bulletins listed for individual specifications.

THE REVISED EDITION of Link-Belt Catalog No. 380 is now off the press and available for distribution. This 96-page book covers the Link-Belt line of standardized monorail electric hoists as well as overhead electric traveling cranes in capacities of ½ to 3 tons, inclusive, giving tables of weights, clearance dimensions and speeds. The numerous photographs of machines in operation indicate that foundries, machine shops and factories of every description are fast coming to a greater realization of the need for installing labor-saving, cost-reducing, production-increasing equipment.

Copies of this book can be had by addressing Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., or any branch office of the company.

A STUDY of Various Types of Belting, is the title of a pamphlet from Edward R. Ladew Co., Inc., 54 Franklin St., New York, embodying information obtained during the course of an investigation on power transmission by belting, which is being conducted by the Mellon Institute of Industrial Research of the University of Pittsburgh, for the Leather Belting Exchange.

CATALOG No. 4, recently issued by Barber-Greene Co., Aurora, Ill., describes the various forms of material handling machines manufactured by that company. Methods of coal storage are suggested in connection with the company's portable conveyors and the application of self-feeding bucket loaders and belt conveyors to the handling of various materials under varying conditions is made clear by numerous illustrations.

THE WESTINGHOUSE Electric & Manufacturing Co. announces that it has received within the past 3 mo. orders from electric power companies for over a half-million horsepower of turbine-generators, which represents the largest volume of power business ever given to a manufacturer by private interests.

These orders form one of the most effective steps that have so far been taken towards the improvement of the general economic situation. The country as a whole is short of power, and in consequence, industry of every kind—from manufacturing to housekeeping—has been seriously hampered. The beneficial effects of this substantial addition to our power supply will, therefore, be felt by the entire nation; and though the total horsepower involved presents only part of our immediate requirements, it is sufficiently large to prove a real factor in the restoration of normal conditions.

Among the orders received by the Westinghouse Co. are the following: Cheswick Power Co., Pittsburgh, Pa., one compound unit of 60,000 kw. (80,000 hp.), which will be one of the largest machines ever built; Narragansett (R. I.) Electric Light Co., one compound unit of 45,000 kw. (60,000 hp.); United Electric Light & Power Co., New York, two compound units of 35,000 kw. (48,000 hp.) each; Brooklyn (N. Y.) Edison Co., two single units of 25,000 kw. (33,000 hp.) each; United Electric Co., Springfield, Mass., a single unit of 25,000 kw. (33,000 hp.); Commonwealth Edison Co., Chicago, one compound unit of 35,000 kw. (48,000 hp.); Havana (Cuba) Electric Railway Co., two single units of 25,000 kw. (33,000 hp.) each.

SPECIALTIES of Strong Machinery & Supply Co., 21 Walker St., New York, are illustrated in a booklet recently issued. These include flexible spring steel packing hooks, engineers' calking tools, packing sticks, etc., with description and prices.

FROM Lynchburg Foundry Co., Lynchburg, Va., we have received a copy of the latest issue of the company's Flanged Fittings Catalog.

THE LINK-BELT Co. is now ready to distribute its 32-page book, No. 345, entitled "Link-Belt Silent Chain Drives for Cement Mill Equipment." This publication enumerates reasons why this drive is ideal for operating ball mills, tube mills, kominuters, conveyors, elevators, lineshafts, quarry-hoists, kilns, dryers and bag filling machines, succeeding pages illustrating many drives in actual operation. Copies will gladly be sent to managers, engineers, superintendents and other officials of cement mills on application to the executive offices of the Link-Belt Co., 910 S. Michigan Ave., Chicago, or any of its branch offices.

WALWORTH EXPORT CATALOG No. 35 has just been published by the Walworth Mfg. Co., Boston, Mass., and is a most complete listing of pipe fittings, valves and tools. Its comprehensiveness may be judged from the fact that it has 24 sections and 400 pages. It is printed in English, Spanish, Portuguese and French, the illustrations being brought out in a strong relief, as they are in a universal language, and text arranged in all languages in proximity to the illustrations corresponding. This necessitates rather small type, hence a yellow tint block has been used under the text, scientific tests having shown that this increases legibility.

Translation to foreign languages was made to carry the spirit of the engineering terms rather than literal words, as many English technical phrases have no exact idioms in foreign languages. The book will not be distributed in this country for this company issues another catalog, No. 78, which shows a full line of American thread fittings.

In the center of the book is a map of the world showing various trade routes between leading cities. Very complete indexes have been given in all four languages so that any article described may be readily found.